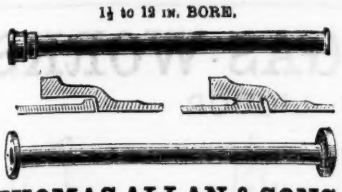
THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LX. No. 1522.] LONDON, JULY 12, 1892. [44TH YEAR. PRICE 6d.

GAS AND WATER PIPES.

1¼ to 12 IN. BORE.



THOMAS ALLAN & SONS,
Bon Lea Foundry,
SOUTH STOCKTON-ON-TEES.

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Parker's Imperial Black Varnish,
Oxide Paints, Oils, and General Stores for Gas and Water Works.

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Are now erecting a four-lift Holder of about 8 MILLION cubic feet,
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CO_2 AND TAR-EXTRACTING WASHERS; SCRUBBERS;
SULPHATE & SULPHUR PLANT;
PATENT SELF-SEALING RETORT MOUTHPIECES;
LIFTING APPARATUS; CENTRE AND FOUR-WAY VALVES;
SOLE MANUFACTURERS OF WECK'S PATENT CENTRE-VALVE;
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IMPROVED CONSUMERS' WET GAS-METERS

IN CAST-IRON CASES,

THE UNVARYING WATER-LINE GAS-METER,

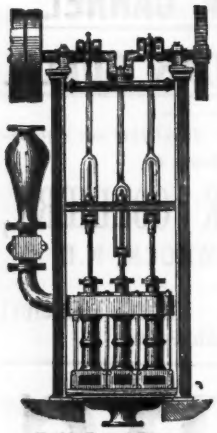
AND

IMPROVED DRY GAS-METERS.

SPECIALITY: PATENT CASH PREPAYMENT METERS.

STEAM & HAND PUMPS FOR GAS-WORKS,

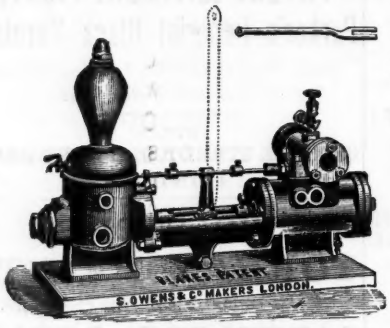
FOR PUMPING TAR, WATER, AND LIQUOR.



Treble-Barrel Pumps in Frame.

Syphon Pump.

Double-Barrel Force-Pump in Frame.



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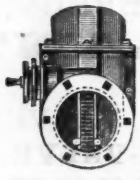

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RETORT-BED FITTINGS,
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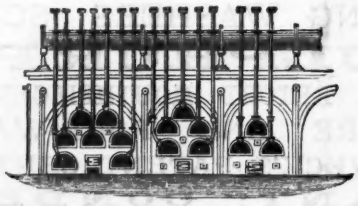

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SCRUBBERS, & WASHERS,
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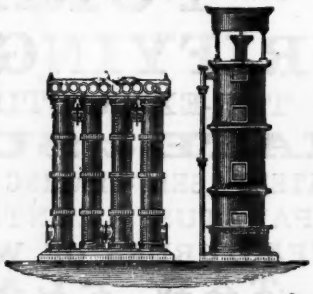

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Also Bye-Pass & Stop Valves.

PURIFIERS with Planed Joints,
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WOOD GRIDS.
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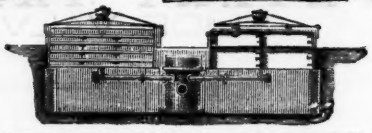

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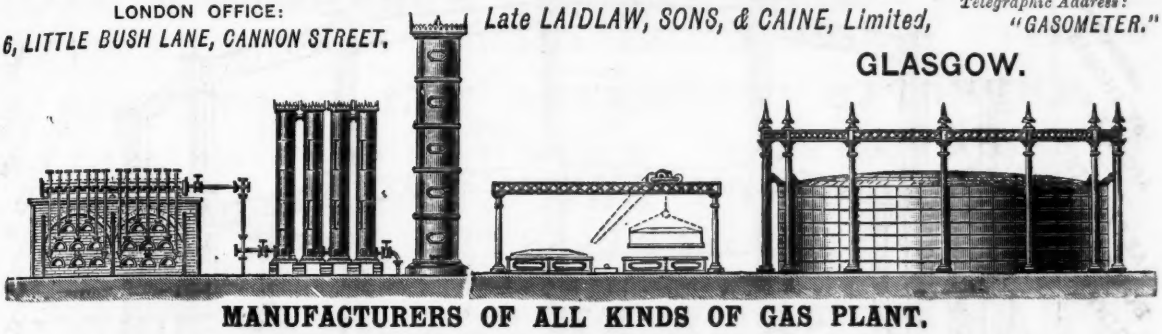

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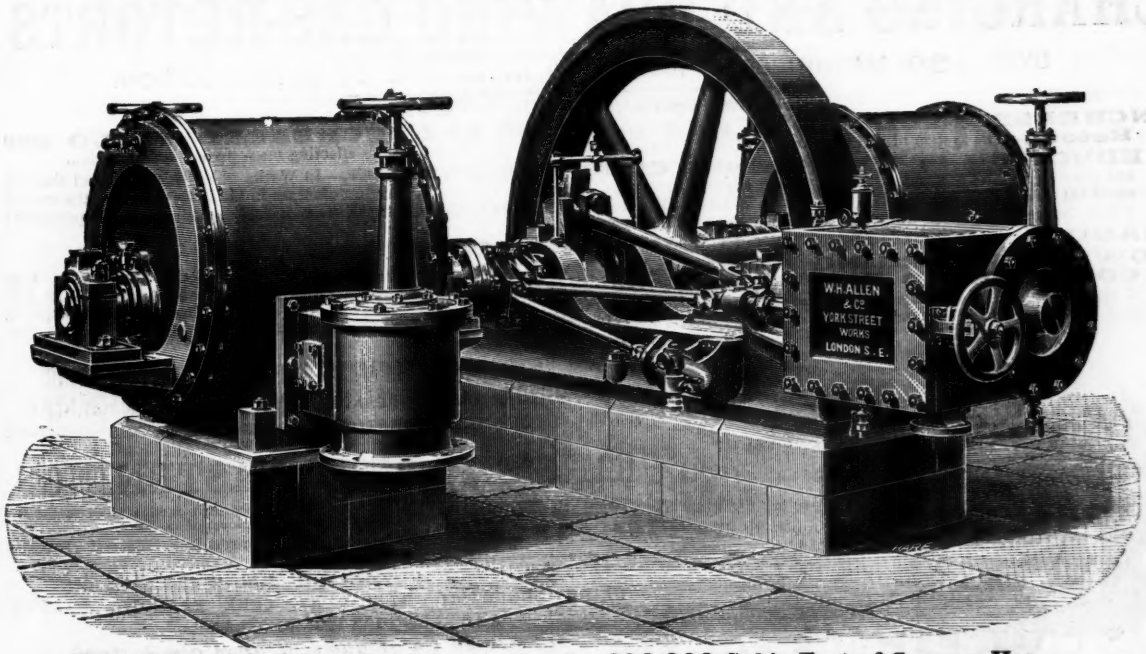
BEALE'S PATENT—ALLEN'S COMBINED SYSTEM.



Pair of Non-Oscillating Exhausters, passing 200,000 Cubic Feet of Gas per Hour.

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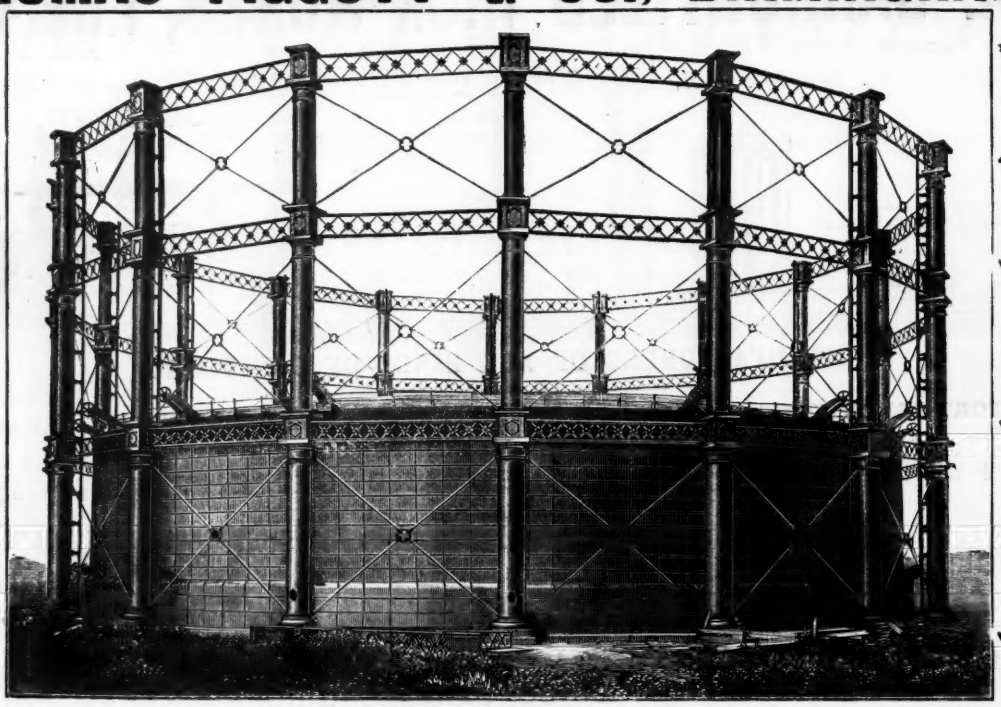

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WELDED & RIVETED PIPES, MAINS, RETORT LIDS, & CAST TANKS, PURIFIERS.

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BECKTON.	BRADFORD.	CARDIFF.	LEEDS.	NOTTINGHAM.	RIO GRANDE.	SYDNEY.
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WEST'S GAS IMPROVEMENT Co., Ltd.,

Engineers, Ironfounders, & Contractors,

ALBION IRON-WORKS, MILES PLATTING, MANCHESTER,

MANUFACTURERS OF

WEST'S PATENTED MACHINERY FOR CHARGING AND DRAWING GAS-RETORTS

OVER **180** MACHINES AT WORK AND IN COURSE OF CONSTRUCTION.

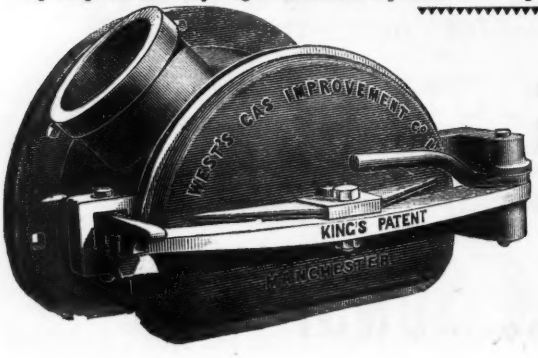
Advantages attending its use are:

INCREASED VOLUME of GAS per TON, and INCREASED YIELD per Retort.—The system of breaking and distributing the coals in an even layer in the retorts effecting more perfect carbonization.

REDUCTION in LABOUR and COST of WORKING.—In Works where this System of charging and drawing Retorts is adopted, there has been effected a substantial saving in the cost of Gas Manufacture in the Retort-House; the amount saved varying in different Gas-Works from **8 PENCE** to **15 PENCE per Ton** of coal carbonized. Full particulars will be forwarded upon application to W. G. I. Company, Limited.

MANUAL CHARGING AND DRAWING MACHINES.

POWER CHARGING AND DRAWING MACHINES, driven by COMPRESSED AIR, STEAM, or ROPE. The power machines are applicable to circular, oval, or Ω-shaped retorts and mouthpieces, and are the most perfect, economical, efficient, and durable machines made. They are constructed on principles founded by long and extensive experience in this special branch of gas engineering and the manufacture of gas.



MAKERS OF COAL BREAKING, ELEVATING, AND CONVEYING MACHINERY, COKE BREAKING AND WASHING MACHINERY.

Sole Makers of CIRCULAR, OVAL, or Ω-shaped MOUTHPIECES with Morton's Self-Sealing Lids, fitted with

KING'S PATENT FASTENINGS,

secure a very tight joint; and at the same time the eccentric motion given to the Lid effectually removes the Tar from the surfaces of the Joint.

N.B.—The whole of these Fittings are made of Wrought Iron. Several Thousands in use.

West's Improved Combined Regulating Liquor Seal Valve.

OXIDE ELEVATING MACHINERY, COKE BARROWS, VALVES, AND ALL GAS-WORKS PLANT, &c.

Illustrated Catalogue sent upon application.

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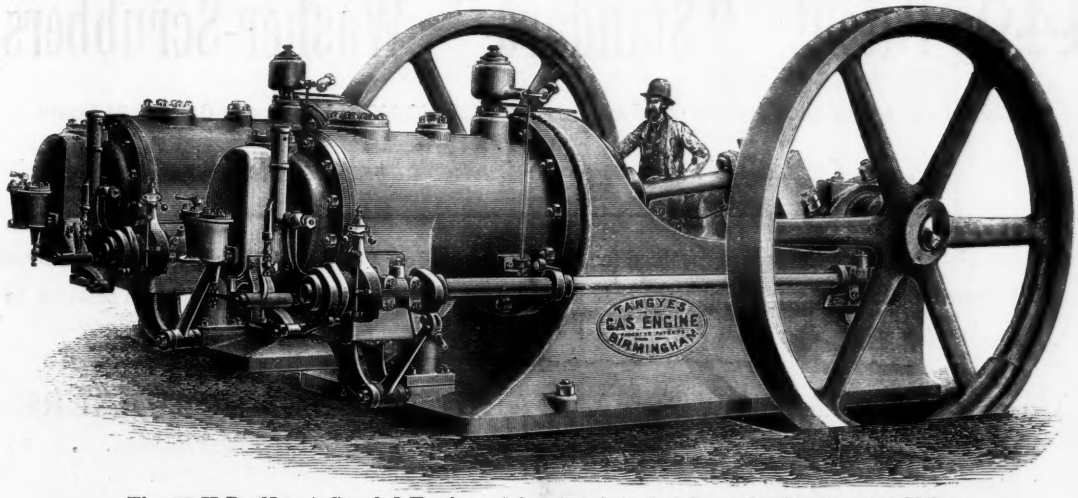
TANGYES' GAS-ENGINE

"OTTO" PRINCIPLE. PINKNEY'S PATENTS.

Messrs. Tangye have laid down special Plant and Tools for the manufacture of these Engines, and are able by their system of MULTIPLE MANUFACTURE and of WORKING TO GAUGE to turn them out in the best possible style.



The 70-H.P. (Nom.) Coupled Engine, giving 172 Actual H.P., and indicating 200 H.P.
Single Engines from ¼ to 146 Actual H.P. (=170 Ind. H.P.) and Coupled Engines from 86 to 292 Actual H.P. (=340 Ind. H.P.

APPLY FOR ILLUSTRATED AND DESCRIPTIVE CATALOGUE OF GAS-ENGINES TO

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MORRIS & CUTLER'S PATENT CONDENSER

IN USE AT OVER 70 WORKS.

NOW UNDER CONSTRUCTION FOR

COLCHESTER,
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MANCHESTER.

CUTLER'S PATENT WATER-VALVES,

ESPECIALLY SUITABLE FOR PURIFIERS.

CUTLER'S PATENT GUIDE-FRAMING,

STRONG, SAFE, CHEAP.

EVERY REQUIREMENT FOR GAS-WORKS SUPPLIED.

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PROVIDENCE WORKS, MILLWALL, LONDON.

KIRKHAM, HULETT, & CHANDLER, LIMITED.

[SIDNEY HERSEY, Managing Director.] [J. CHANDLER, Engineer.]

449 Patent "Standard" Washer-Scrubbers,

Capable of extracting the whole of the Ammonia from 426,560,000 Cubic Feet of Gas per 24 hours,

Erected and in course of construction at present date.

The following List comprises the orders received for Improved PATENT "STANDARD" WASHER-SCRUBBERS constructed according to the Company's latest patent, and Renewals effected by the application of same to old pattern Machines.

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Birmingham	5,000,000	Kilmarnock	1,000,000	Lyons-Vaise (France)	525,000
Beckton	3,500,000	Dover	1,000,000	Barry and Cadoxton	500,000
,,	3,500,000	Colchester	1,000,000	Workington	500,000
Kensal Green	3,000,000	Cambridge	1,000,000	Lowestoft	500,000
,,	3,000,000	West Bromwich	1,000,000	Newton-le-Willows	500,000
Liverpool	3,000,000	Luton	1,000,000	Manchester	400,000
,,	3,000,000	Alger (Algieria)	875,000	Erfurt (Germany)	400,000
Croydon	3,000,000	Valencia (Spain)	875,000	St. Chamond (France)	350,000
West Ham	3,000,000	Barcelona (Spain)	875,000	Santander (Spain)	350,000
Rochdale	3,000,000	Nice (France)	875,000	Atlas Steel Works, Sheffield	250,000
Paris	3,000,000	Stockport	800,000	Bangor	250,000
,,	3,000,000	Magdeburg (Germany)	750,000	Lille (France)	250,000
Glasgow	2,500,000	Altoona (U.S.A.)	750,000	Melun ,,	210,000
,,	2,500,000	Smethwick	750,000	Valencia (Spain)	200,000
Manchester	2,500,000	Schneider-Creusot Works		,, ,,	200,000
Leicester	2,250,000	(France)	735,000	Vercelli (Italy)	200,000
Swansea	2,000,000	Valparaiso (Chili)	600,000	Rawmarsh	200,000
Bordeaux	2,000,000	Halle (Germany)	600,000	Baccarat (France)	175,000
Melbourne	1,500,000	Elberfeld ,,	600,000	Hitchin	150,000
Charlottenburg (Germany)	1,500,000	,, ,,	600,000	Sydney	100,000
Derby	1,500,000	Nancy (France)	525,000	Balson-Chateauroux (France)	70,000
,,	1,000,000	,, ,,	525,000		

RENEWALS.

Birmingham	5,000,000	Hastings	1,500,000	Heckmondwike	500,000
Nine Elms (in part)	3,000,000	West Ham	1,500,000	Hampton Wick	500,000
Vauxhall ,,	3,000,000	Nottingham	1,500,000	Kingston-on-Hull	400,000
Dublin	3,000,000	Melbourne	1,500,000	Weston-super-Mare (in part)	400,000
Shoreditch (in part)	2,500,000	,,	1,500,000	Enfield	300,000
Beckton	2,500,000	Crewe (L. & N.W.R. Co.)	1,250,000	Harrow	250,000
Manchester	2,500,000	Beckton	1,250,000	Buxton	250,000
Bromley	2,000,000	,, (in part)	1,250,000	Quebec, Canada (in part)	250,000
Pimlico (in part)	2,000,000	Bradford	1,250,000	Newmarket	150,000
Plymouth	2,000,000	Maidstone	1,000,000	Leominster	150,000
Croydon	1,500,000	Smethwick	750,000	Kidsgrove	100,000
Edinburgh	1,500,000	Heywood	600,000		

All New Patent "Standard" Washer-Scrubbers are fitted with the Company's Patent Improved Wooden "Bundles" or Washing Devices, which can be readily fitted to old pattern Machines.

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IMPROVED STREET LIGHTING

AND

THE AVERAGE METER SYSTEM FOR STREET LAMPS.

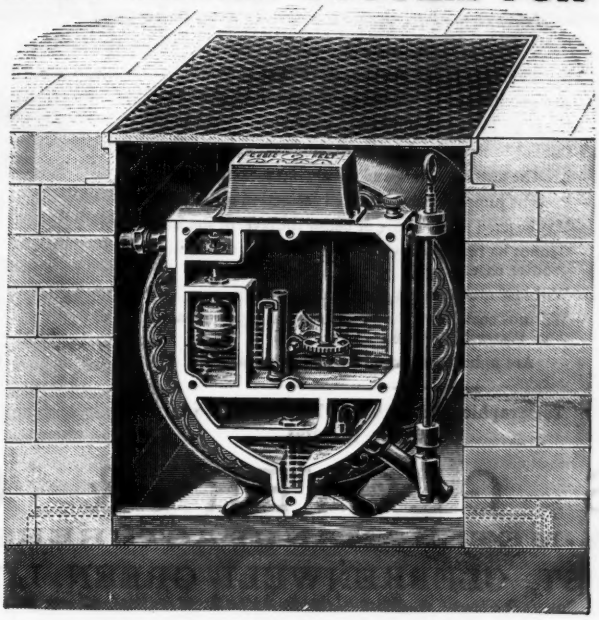
The Illustrations show the various Arrangements of Meters for these purposes. The cases are of cast iron; and the sizes are up to 20 lights for Brick Tank and Iron Box, and up to 5 lights for Pillars. Are largely used in London and Provincial Towns, giving great satisfaction. This is chiefly due to Meters being on the **WARNER & COWAN** Principle. Its advantages are:—

Correct Registration, with Variable Water Line.

Long Float Range, preventing Valve being Closed by Vibration from Traffic.

Frequent Inspection unnecessary, as Meters need only be watered at intervals of nine to twelve months.

To prevent Freezing, a little Glycerine should be mixed with Water when severe frost sets in.

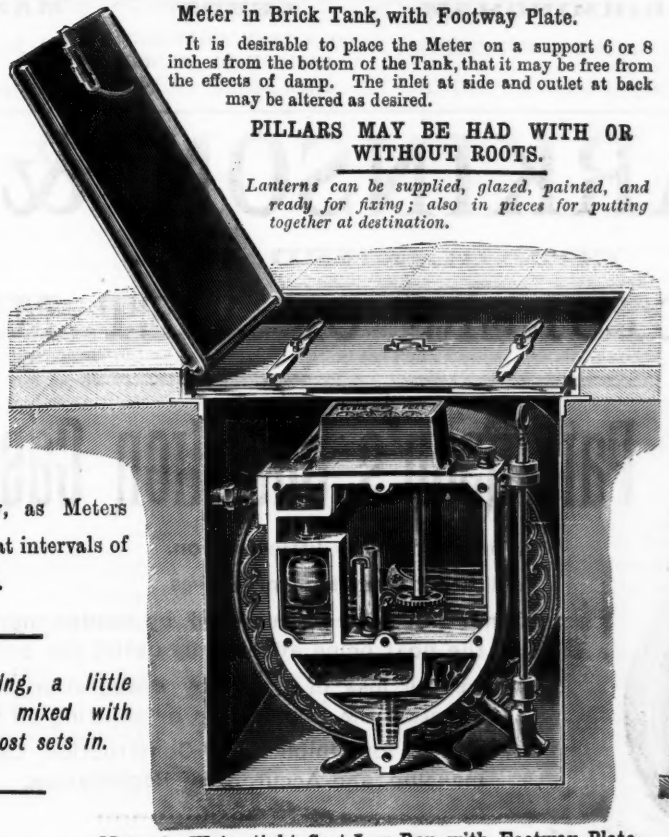


Meter in Brick Tank, with Footway Plate.

It is desirable to place the Meter on a support 6 or 8 inches from the bottom of the Tank, that it may be free from the effects of damp. The inlet at side and outlet at back may be altered as desired.

PILLARS MAY BE HAD WITH OR WITHOUT ROOTS.

Lanterns can be supplied, glazed, painted, and ready for fixing; also in pieces for putting together at destination.



Meter in Water-tight Cast-Iron Box, with Footway Plate.

WARNER-COWAN METER IN STREET-LAMP PILLAR.

W. & B. COWAN,

LONDON, MANCHESTER, AND EDINBURGH.

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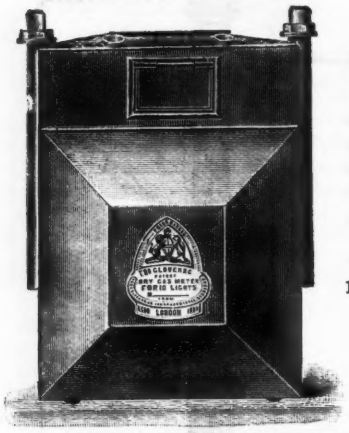
[ESTABLISHED 1844.] **ORIGINAL MAKERS.** [ESTABLISHED 1844.]

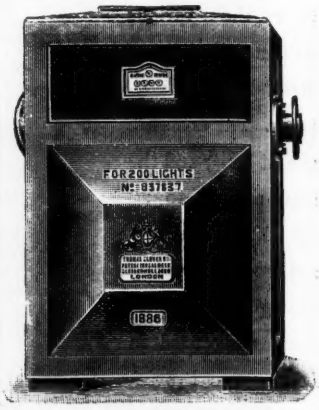
LONDON, 1851. NEW YORK, 1853. PARIS, 1855. LONDON, 1862. DUBLIN, 1865. PARIS, 1867.

THE SIX MEDALS AWARDED TO THOMAS GLOVER'S PATENT DRY GAS-METERS;
The latter being the Highest Award for Dry Gas-Meters at the Paris Exhibition, 1867. Since then we have not Exhibited FOR PRIZES.



1st.—Are a remedy for all the defects of Wet Meters.
2nd.—Are suitable for all Climates, whether hot or cold.
3rd.—Incur no loss of Gas by Evaporation.
4th.—Cannot become fixed by Frost, however severe.
5th.—Are the most accurate and unvarying measurers of Gas.
6th.—Prevent jumping or unexpected extinction of the Lights.
7th.—May be fixed either above or below the level of the Lights.
8th.—Cannot be tampered with without visibly damaging the outer case.
9th.—Will last much longer than Wet Meters.
10th.—Will not cost more than one-half for repair that Wet or Water Meters do.

Are upheld for five years without charge.



Telegraphic Address: "GOTHIC LONDON."
Telephone No. 6725.

THOMAS GLOVER & CO.,

DRY GAS-METER MANUFACTURERS,

214 to 222, ST. JOHN ST., CLERKENWELL GREEN, LONDON, E.C.

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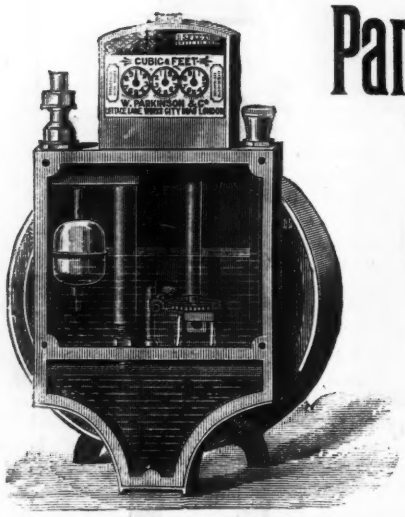
Telegraphic Address: "GOTHIC."	*Telegraphic Address: "GOTHIC."*	*Telegraphic Address: "GOTHIC."*	*Telegraphic Address: "GOTHIC."*

W. PARKINSON & CO.

ESTABLISHED 1816.

MANUFACTURERS OF WET METERS.



Parkinson's Cast-Iron Case Meter.

Works with very little friction.
Will stand very high pressures.
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[See also Advt. p. 66.

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THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, JULY 12, 1892.

The Manchester Gas Undertaking—A Suggestion.

IN another part of the JOURNAL will be found the report and the principal portions of the accounts just issued by the Gas Committee of the Manchester Corporation. The former does not go into contentious matters, but merely runs over the chief figures of the accounts. In the latter some important changes appear, the full significance of which can only be understood by those who have followed up the recent developments of policy of the Corporation. Dealing first with the general statistics of the twelve months' operations, it appears that 1·23 per cent. more coal and cannel were carbonized in the last municipal year than in the previous period; while the increase of gas consumption was 3·12 per cent. This difference should be ascribable to improved working. The gas-rental of the Department amounted to £398,086. Coke brought in £39,797; tar stands for £35,437; and ammoniacal liquor was good for £23,363. For the first time the value of the gas used for public lighting appears as an entry in the revenue account; being charged upon the City Fund. Coal cost £234,284, or an average of 13s. 4·11d. per ton, being an advance of 1s. 0·25d. upon the previous year. Retort men's wages work out at 2s. 8·2d. per ton. The gross profit for the year was £114,611, after charging repairs and maintenance. Out of this come first the fixed charges—£26,379 for interest, and £13,954 for the sinking fund. Then the sum of £9085 is written off the balance of public lamp capital account, and £55,596 is the amount of the subsidy paid into the City Fund. A further sum of £9596 is applied to a contingent fund for extraordinary renewals of plant—that is to say, it is just a little appropriation to capital account. The City Council have prevented the Committee from reducing the price of gas; but the ratepayers are not to have all the surplus revenue, if the Committee can help themselves. It will be noticed that the usual payment to the depreciation fund does not appear this time. It is for this reason that the Committee are able to hand over so handsome a subsidy to the City Fund, the greater part of which is needed to assist the Thirlmere water scheme. When this is provided for, it will be the turn of electricity. Consequently, the Manchester gas consumers need not hope for a cheaper supply within any period for which a practical people can take thought. There is one thing to be said for the Manchester Gas Committee—they publish clear and detailed accounts. They tell the public what their work costs to do in every department, even to stating the names of, and salaries paid to, their officers. This is a part of the accounts that can hardly be described as reflecting much lustre upon the Corporation. We think, and have often taken the opportunity of saying, that the Manchester Gas Committee do not pay their officers well. Let us admit, however, that there has of late been a slight improvement in this respect; but a radical change would have to be made in the organization of the engineering branch, in order to render Manchester independent, as it ought to be, of outside advice in all conceivable circumstances. Manchester should be a school of gas engineering to which all the surrounding region could look up; but at present it is just the opposite. We do not mean by this to imply that the Station Managers in the service of the Manchester Gas Committee are not competent men in their degree. It is the lack of headship and initiative that strikes the observer of the gas administration in that city. However, this is an old story; and so long as Manchester chooses to go on paying for its blunders, it must be permitted to amuse itself in its own way.

But to return to the subject of salaries. Why is not the same publicity carried out with respect to wages? We have no sort of objection to raise to the principle of publishing the names and salaries of corporation officials. It is a principle that should always be followed in regard to salaries to officers who are paid out of public funds. The point now arises, however, as to whether it would not be advisable to extend the practice so as to include in the accounts of a municipal department a statement of the rates of wages paid and hours worked, and the average numbers of men employed. We lay this suggestion before all whom it may concern. There is no valid reason why what is good for the officers of a municipality in the matter of publicity should not also hold good for the men. The principle is of general validity, or of none. If we may so far digress from the immediate subject of the affairs of the Manchester Gas Department as to offer a remark upon the wider bearing of the suggestion now under discussion, it shall be to express the pained surprise with which we noticed how many of the contributors of the labour statistics relating to the gas industry which Mr. W. A. Valon submitted a few weeks ago to the Royal Commission asked that the names of their works might not be made public. What, in the name of all that is reasonable, has the management of a public establishment like a gas-works to fear from the publication of the rates of wages paid to, and hours of labour of, the workers? There is no real secrecy about the matter; for everybody may know these things

who cares to inquire about them. Why not, then, proclaim them fully and freely? Therefore, to return to the case of Manchester, we hope Mr. Nickson, the Superintendent, whose sympathy with the working population of the city needs no advertisement here, will see his way clear to bringing this point of publicity under the notice of his Committee, so that the next financial statement relating to the working of the Gas Department may be even fuller than the present.

An Experiment in the Settlement of Labour Disputes.

When giving evidence before the Labour Commission, Mr. W. Thorne, the General Secretary of the Gas Workers' Union, said, with reference to the successful replacement by the South Metropolitan Gas Company of their old retort hands with new men on the occasion of the historical strike, that he did not think the police ought to interfere in such matters. Dissatisfied with the peaceable result of police action in the South of London, when, as it happened, the strikers were "left in the lurch," Mr. Thorne would have preferred fighting the matter out according to the methods and instincts of the natural man. What this alternative course means in practice has just been shown by the deplorable proceedings arising from the strike and lock-out at the Homestead Steel-Works, near Pittsburgh, Pennsylvania, owned by Mr. Andrew Carnegie, the Scoto-Yankee millionaire, who, having made his fortune in America, by M'Kinleyism, prefers to spend it elsewhere. The story is so impressive that it has been told in every newspaper in the world during the past week; and the comments which it has suggested have been, as might be expected, of diverse nature and bearing. Yet little comment is needed; for, like all tales of moving human interest, this proclaims its own moral. Although readers of the Journal have doubtless ere now become familiar with the story, we must repeat it, as succinctly as possible, for the sake of the record. Briefly, then, it appears that, notwithstanding M'Kinleyism, the managers of the Homestead Steel-Works found it necessary to reduce the rate of wages they were paying their men; and they notified the fact in the ordinary course. Thereupon the workers protested; and a Trade Union took the matter in hand on behalf of the men—threatening a general strike if the notices for the reduction were not withdrawn. The employers refused to recognize the Union; and they anticipated the strike by a wholesale lock-out. So far the proceedings were of the most ordinary, not to say humdrum character on both sides; and if the employers had been content to stop their works, the difficulty would doubtless have settled itself in the usual way, by the tiring out of one or the other of the resisting parties. The employers, however, decided to try to keep the works going by introducing fresh hands; and then the worst of the trouble began. The *posse comitatus* of an American Sheriff is always a poor affair; and there was certainly no force at the disposal of the Sheriff of the county in which the Homestead Steel-Works are situated competent to keep in check 5000 infuriated foundrymen bent upon the annihilation of the strangers who were to be imported for the purpose of taking the bread out of their mouths. Here, again, the employers might have submitted to the apparently inevitable. They did differently, however; and, with the object of taking the defence of their works and new workmen into their own hands, they engaged a force of mercenaries known as "Pinkerton's Detectives." The advent of these men upon the scene was tantamount to the declaration of civil war. The locked-out foundrymen flew to arms; and a rough-and-tumble engagement followed, in which about a score of men were killed, and thrice the number wounded on both sides, before victory declared itself against the mercenaries.

Is this the sort of thing that Mr. W. Thorne would like to see here in place of the impartial police force keeping the Queen's peace? For it must be borne in mind that, sanguinary as the Homestead fight was, it was nothing but an immaterial incident in the course of the real struggle. The mob of strikers may have defeated the horde of mercenaries employed to protect the steel-works which M'Kinleyism has built up; but they cannot force the employers to pay one cent more in wages than they choose. Hence it is evident that the violence on both sides has really done nothing to affect the settlement of the true issue, which will be decided for precisely the same reasons, and no others, as would have governed it if the Pennsylvanian Sheriff had been strong enough to quell rioting in his nominal charge. Workmen may see by this that it is as much to their interest as to that of any other class of the community that the peace should be kept. Now and again ignorant men of strong feelings but weak judgment will arise and proclaim their desire to settle labour difficulties "without the interference of the "police." But this Pittsburgh incident surely ought to be enough to convince the most headstrong of these agitators that where violence is allowed, it is a game that two can play at, and to the injury of both. True liberty vanishes when any class or section of the body politic thinks it can set at defiance the laws and guarantees of social security merely for its own immediate purpose, however plausible. As one newspaper commentator pointedly says: "Freedom can only exist where all rights are "secured." This is a generality, the force of which, as of so many other sayings of the kind, needs to be brought out by examples. In a country so settled as England, where serious resistance to the civil authority, for interested reasons, is hardly ever heard of, and where the dangers of anarchy are so far removed that many newspaper writers can afford to applaud the small Irreconcileables who strive after the cheap martyrdom of the Police Court in order to "assert the right of public meeting" in prohibited places—in this country, let us say, it is specially desirable that the lesson of the Pittsburgh riots should be duly learnt by the class that needs it most. If another result of these disturbances should be to move Mr. Andrew Carnegie to betake himself and his millions to the regions where both seem most needed, nobody on this side of the Atlantic would complain.

The Barnet Arbitration.

The last stage of the remarkable progress (?) of electric lighting at Barnet is now completed; and the Local Board get rid of their obligations to their electric lighting contractor for a round sum of £500. A report of the arbitration proceedings which have eventuated thus will be found in another column. The chronicle is worth preserving as a record of the trouble into which a local authority may unwittingly get if they tamper with strange lights. In one sense, the story of the Barnet Local Board and Mr. Joel, the electrician, is a part of ancient history; for no local authority of the United Kingdom will be likely henceforward to rush into electric lighting by contract, in the same way as the Barnet people did. When the ill-considered experiment had to be abandoned, at the dictate of common sense and in the interest of public security, the Local Board were served by their contractor with a little bill for something between £5000 and £6000—the contractor appearing not to be altogether sure of the ground upon which he could best make his claim, which was rather farcical, but at any rate had to be investigated. Accordingly, the matters in dispute were referred to arbitration—that blissful discovery for modern lawyers and surveyors. The arbitrators in this particular case seem to have exercised a sound judgment. They very soon swept away all Mr. Joel's ridiculous claims for loss of prospective profit, consequential damages, and other suggested detrimental results of the failure on the part of the Board to agree to Mr. Joel's project of establishing himself at Barnet with statutory powers; but they have given him a *solatium* of £500 in consideration, apparently, of his having entered into a losing contract which he nevertheless carried out to the best of his ability. The award is, in effect, a fine upon the Local Board for having allowed the public lighting of their district to be played with by a speculator who had no prospect of dealing with it in a permanently successful manner.

Things One Could Do Without.

Those very peculiar daily newspapers published in London as "financial organs," have fallen upon hard times of late. The dearth of business in the speculation market has hit all the mushroom brood of "financial" journals very hard; for full-page and half-page displayed advertisements of new ventures are now no longer to be had by dozens every week, at fancy prices, in consideration of a judicious puff, or even of a discreet silence respecting the reputation of promoters. Consequently, these publications are not quite so numerous as they were a year or two since; and those that remain are wofully shorn of their pristine dimensions. They are driven, moreover, to deal to a greater extent in tittle-tattle of the feeblest, in place of the stirring advocacy of some

ventures that came "properly recommended," and the pointed denunciations of others, with which their conductors once caught the public eye. It is amusing to follow for a week or two the desperate devices wherewithal the financial newspaper editor now fills his columns. Only the other day we noticed one sheet of the class placarded as containing an article on "The Great Renunciation." Wondering what this might be, we examined the paper, only to discover that the sounding phrase related to the report about the stockbrokers on the Madrid Bourse having struck work as a protest against the imposition of a tax upon their dealings. The trifling bit of news was turned over and over many times, and made the text of a homily about the curious effects that might be looked for if a variety of other classes of a modern community were to take the same course. "What if the Spanish stock-"brokers had proved by their strike that they are not "absolutely necessary to the comfort or the convenience "of mankind?" Ah, what, indeed! But it may occur to our readers, as it certainly did to us, that reflections of this nature must have an application too near home to be comfortable in the appreciation of a financial journalist. Supposing all the stockjobbers' publications of this kind to perish from the land to-morrow, would anybody be one penny the worse? It is a question that few would like to answer offhand for themselves, under the obligation "to tell the truth, the whole truth, and nothing but "the truth." The necessity for justifying our existence is one under which we all in theory lie; but nevertheless we are startled when brought face to face with it in the shape of a practical, concrete question. Let us turn the subject back from the general to the particular again by remarking that, so far as the gas industry of the United Kingdom is concerned, we most devoutly wish the professional financiers would leave it alone. There have been no "Lothammer" gas schemes for a year or more, it is true; and the relief is something to be thankful for. But there has been a good deal of tampering with gas stocks, which term means, to the ordinary stockbroker, Gaslight and Coke "A" stock, because this is the representative gas stock—the only one of which enough exists under one denomination to attract the attention of "operators" for the rise or fall. This meddling has not done it any good; and we wish these gentry had left it alone. As it is, every time a Capel Court man stumbles over one of the trenches with which the City of London Electric Lighting Company have been rendering the streets impassable for months past, he swears that gas must be in a bad way, and his objurgations are recorded on the official lists. So soon as the streets of the City are in order again, gas stocks will insensibly rise. All the same, the nuisance is a grave one while it lasts.

Death of Mr. R. Ward.—The death is announced of Mr. Reginald Ward, who was for many years Solicitor to the Metropolitan Board of Works, and subsequently, for a short time, to the London County Council. Deceased was in his 64th year.

The Gas Industry in Parliament.—As far as the General Election has proceeded, the members of the late Parliament interested in the gas industry who again sought the suffrages of their constituents have retained their seats. Mr. John Aird has been returned for South Paddington, and Sir Julian Goldsmid will continue to represent South St. Pancras, notwithstanding much opposition in each place. Sir F. T. Mappin, Chairman of the Sheffield Gas Company, whose name was inadvertently omitted from our remarks in the JOURNAL for the 28th ult., was last Wednesday re-elected unopposed for Hallamshire. Mr. D. Ford Goddard was unsuccessful at Ipswich; but he was beaten by only a small majority.

The Sanitary Institute.—We have received from the Secretary of the above Institute (Mr. E. White Wallis, F.S.S.) the preliminary programme of the thirteenth congress, which is to be held at Portsmouth from the 12th to the 17th of September next. The proceedings will be opened with a reception by the Mayor; to be followed in the afternoon by the address of the President (Sir C. Cameron, F.R.C.S.I.). Conferences of naval, military, and domestic hygienists, medical officers of health, municipal and county engineers, and inspectors of nuisances, will be arranged on the second day, which will close with a lecture by Sir T. Crawford, K.C.B. Sectional work will occupy the three following days; and the final day will be reserved for excursions. The Mayor will give a *conversazione* on the evening of Sept. 14; and the congress will close, as usual, with an address to the working classes, by Professor W. H. Corfield, M.A., M.D. In connection with the meeting there will be an exhibition of sanitary appliances and articles for domestic use and economy, which will remain open till the 8th of October.

WATER AND SANITARY AFFAIRS.

MR. J. W. BENN, the "Whip" of the Progressive Party in the London County Council, now takes the place of Mr. Ritchie as representing St. George's-in-the-East in Parliament. The fate which has thus overtaken the President of the Local Government Board must be particularly gratifying to the party which considers the County Council to have been persistently snubbed by Mr. Ritchie and his colleagues. We have nothing to do with party politics in these columns; but the event to which we refer has a certain relation to the question of the Metropolitan Water Supply. Mr. A. J. Balfour has declared it as his "personal opinion" that London "should have the powers as regards water and gas and all "those questions which other municipalities have." But Lord Rosebery complains that Mr. Ritchie and the Government have acted in a manner contrary to this declaration, and have thwarted the Council in its efforts to deal with the water supply and sundry other matters. Mr. John Hutton, the prospective Chairman at Spring Gardens, furnishes the *Pall Mall Gazette* with a list of Bills promoted by the County Council which have either failed to pass through Parliament or have been materially altered in their passage; and this is cited as "the record "of the Government towards the County Council." Among the projects included in this list, we find the Water Supply Bill of 1891, which is said to have been "dropped in "consequence of opposition." But we do not see that the Government are to be blamed for this event. Another item is that of the London Water Bill of the present year, which underwent material alteration at the hands of a Select Committee. Because they have not interposed in Parliament to back up the schemes of the County Council with reference to the water supply of the Metropolis, it is urged that the Government are not dealing faithfully with the municipal authority which they have themselves brought into existence. But the Progressive pace is a fast one, while the Government feel it proper to proceed with caution. It ought to be sufficient to know that the subject of the London Water Supply is being laboriously investigated by a Royal Commission, from whom an important report will ultimately proceed. Mr. Benn, who has ousted Mr. Ritchie from his seat in Parliament, comprehends in his "program" a number of demands on behalf of the County Council, including the possession of the water supply. Supposing Mr. Balfour's "personal "opinion" to be adopted by the Government, the end in view may yet be sought after a manner very different from that pursued by the Council. If the Council feel that they have been slighted by the Cabinet in respect to this matter, they may thank themselves for their ill fortune. Their zeal on the subject of the water supply has resolved itself into an attack on the Companies, accompanied by an obvious determination to coerce the latter into a surrender of their property on ruinous terms. A policy of this kind is certainly not the way to obtain the support of a Conservative Government, nor is it likely to meet with approval in the deliberations of Parliament, whichever party may be in power.

The controversy over Lord Cross's scheme of 1880 for the purchase of the Metropolitan water undertakings has been expanding during the last few days. Sir W. Harcourt has replied to Mr. A. J. Balfour in two letters, Sir T. H. Farrer has written twice to *The Times*, and two able communications have appeared from a correspondent who aptly signs himself "Accountant." Reference is made to Mr. Burdett's annual publication; the current issue dealing with the finances of the London Water Companies at considerable length. Sir T. Farrer, in his second letter, published yesterday, tries to shift the ground of the controversy, by debating what would have been the amount of profit accruing to the shareholders of 1880, had the bargain then proposed been carried out. But the real point to be settled, and in which the public are directly interested, is whether the ratepayers have been losers or gainers by the abandonment of Lord Cross's scheme. Calculations differ widely—Sir T. Farrer contending that, between the years 1880 and 1890, the ratepayers have made a gain of £1,057,539 by the rejection of the agreements; while Mr. Burdett, on the contrary, shows that the net result up to the 30th of September, 1891, as affecting the ratepayers, probably represents a loss of about £950,000. "Accountant"

deduces a somewhat different result from Mr. Burdett's figures, and states that they show a loss to the ratepayers of £1,021,510 down to September, 1890—the period taken by Sir T. Farrer. The economies in working expenses, to be effected after the unification of the undertakings, form a material feature in the estimate. Mr. E. J. Smith put these as constituting a sum of £96,000 per annum; and Mr. Burdett remarks that no attempt seems to have been made to controvert the substantial accuracy of this reckoning as to the savings. But Sir T. Farrer is "far from admitting" that, in calculating the compensation to be paid to the Water Companies, "we should include economies which are effected not by "them, but by the municipality to whom they sell." In arguing after this fashion, Sir Thomas forgets that the present discussion turns on the question as to how the ratepayer would have been affected had the undertakings been transferred on the terms proposed. If there would have been a saving of £1,080,000 in the working expenses by September, 1891, it would surely have been so much the better for the ratepayer; the amount more than covering what Sir Thomas calculates would be the loss by September, 1890. While an objection is urged against embodying the coming savings in the original bargain, it is considered quite proper to lop off from the purchase-money the cost of future extensions. Sir T. Farrer says the outlay of capital by the Companies since 1880 has been considerable; causing "immediate loss to the shareholders," while there is no recoupment for many years. Let the current loss on the new capital be what it may, there is an income, and on that income the present calculations are based. As for the probable expenditure of capital henceforth, the Companies give no sign that they are afraid to face the contingency; and they manifest no desire to escape their responsibilities by selling off their concerns. But the savings by unification do not represent all that appears in favour of the negotiations made in 1880. Neither is it fair to test Mr. Smith's terms without allowing for the reduction of income brought about by the arbitrary interference of Parliament in 1885, when the Water-Rate Definition Act was passed. The income of the Water Companies was thus cut down in a way which no one had a right to anticipate five years beforehand. Still the Companies have prospered; and the County Council would greatly like to possess their revenue.

Pipe-Founding in Japan.—Japan threatens to make herself independent of outside makers of iron tubes; it being reported that the pipes required for the water-works for Osaka are to be cast in the Military Arsenal in that city.

The Management of the Carnforth Water-Works.—The Directors of the Carnforth and District Water-Works Company, Limited, have entrusted Mr. H. Lawton, Manager of the Carnforth Gas Company, Limited, with the supervision of their undertaking, as they are desirous of carrying out certain alterations at the works with the view of affording a better supply of water to the town. The duties will not interfere in any way with those connected with Mr. Lawton's position with the Gas Company, which he will continue to hold.

The Electrical Supply Business in London.—In an article on this subject in the current number of the *Electrician*, it is stated that the total number of units sold during last year was a little more than 4¼ millions, which, taking the 8-candle lamp at 32 watts, and equivalent to a 5-feet gas-burner, corresponds to 132,800,000 lamp-hours, or 664 million cubic feet of gas. The output of The Gaslight and Coke Company for the half year ending Dec. 31, 1891, was 10,000 million cubic feet; so that the whole of the electric lighting by supply companies corresponds at present to only 6·64 per cent. of the output of this one Company.

The Lighting of Johannesburg.—In the JOURNAL for the 28th ult., we announced that some of the principal streets of Johannesburg had just been lighted by gas. From more recent advices, we learn that the gas is very satisfactory; and that the demand is greater than the present means of the Johannesburg Lighting Company, Limited, are able to meet. The Managing Director of the Company (Mr. W. F. Lance), writing towards the close of May last, stated that he was being pressed on all hands to extend both gas and electric plant; and a few days later he said there was no fear of his having too much of the latter. His only difficulty was as to how to deal with all the applications he had. With regard to gas, much the same condition of things existed. There were then between three and four miles of mains laid; and Mr. Lance was being pressed to take the pipes in all directions. He estimated that about £5000 should be spent in this work as quickly as possible; and although this would probably not suffice for all future requirements, as the town is growing very rapidly, it might serve for a time.

THE INCORPORATED GAS INSTITUTE.

PROCEEDINGS AT THE TWENTY-NINTH ANNUAL GENERAL MEETING,

HELD AT THE

INSTITUTION OF CIVIL ENGINEERS, JUNE 14, 15, & 16, 1892.

Mr. W. A. VALON, Assoc.M.Inst.C.E., President.

DISCUSSIONS ON THE PAPERS.

We conclude to-day our report of the discussions on the papers read at the above meeting.

MR. WALMISLEY'S PAPER ON THE EXTERNAL VERTICAL STANDARDS OF GASHOLDER FRAMEWORK.*

The PRESIDENT said the members were much indebted to Mr. Walmisley for his paper. It was scarcely one which could be discussed; but there might be certain points taken up by some of the gentlemen present. The paper itself was of an exhaustive character; and he felt sure it would, as part of the Transactions, be referred to again and again, for a long time to come, as an authority on the subject of which it treated.

Mr. S. CUTLER expressed the great obligation which he thought the Institute were under to Mr. Walmisley for his very excellent, exhaustive, and learned contribution to the literature extant relating to gasholder construction. The nature of the paper was such that it obviously did not lend itself to immediate discussion. But it was well worthy of careful perusal and study; and, for his own part, he was quite sure that he should find it useful for reference in his own practice. Mr. Walmisley had been good enough to refer to a type of gasholder guide-framing with which his (Mr. Cutler's) name was identified, and which he thought was a kind of structure that was well worthy the attention of all who were contemplating work of the kind. It had been the outcome of a tolerably long experience of the nature of, and defects in, gasholder guide-framing as formerly made—an experience which had confirmed him in the opinion that a framing consisting of massive standards or columns, tied together by comparatively light girders and bracing, was not necessarily a strong one. The essential feature with regard to his framing was constructing it as one cylindrical self-contained standard, equally strong in all its parts, and of which all the parts were capable of doing duty as struts. As probably most of the members knew, a year or two ago there were constructed in the Midlands two very large gasholders, the guide-framings of which were extremely well designed. They consisted of standards braced by horizontal girders and strong flat iron ties; but the difficulty that was found was to accurately adjust these ties. Differences of temperature had, as they all knew, a marked effect on the length of metals; and a tie that was of the proper length when riveted up at one temperature, became quite inaccurate when the changes that occurred in this climate—sometimes very suddenly—had taken place. This feature in metal structures was one that should be very carefully kept in mind; and it affected considerably the importance to be attributed to mere theoretical values of various members of a complex structure such as a gasholder guide-framing, and would very materially reduce the real value of ties. The kind of framing he had devised ensured every member being able to do its duty; and thus it was most economical. In a recent case in which they had prepared estimates, a saving of £3000 in £25,000 was shown to be possible.

Mr. GADD said those who would carefully read and study Mr. Walmisley's paper would find it of great value. His (Mr. Gadd's) opinions with regard to actual guide-framing might not be considered worth very much, as it was well known that he regarded such framing as unnecessary. Still he thought he could form a fairly independent opinion of the various forms of columns and girders which had been from time to time employed. If he understood the purport of Mr. Walmisley's paper aright, it might be expressed something in this wise: If it were necessary to have guide-framing at all, it should be so constructed as to approach as nearly as possible to a perfectly rigid circle. This seemed

* See *ante*, p. 17.

to be the idea, put into simple language, which underlaid the calculations so ably brought forward by Mr. Walmisley; and with this he cordially agreed. The nearer they could bring the girdle of framing to a perfectly rigid circle, incapable of distortion, the more perfect guide-framing they had. From his observation and study of structures generally, he was of opinion that the simple column form, either in cast or in wrought iron, set widely apart, with very little bracing, was the very worst form that could be adopted. Instead of concentrating a great weight at certain points, it was much better to distribute it at more frequent intervals, and employ lighter columns, strongly braced together, so as to produce something like a rigid cylinder. This seemed to be the drift of Mr. Walmisley's paper, and of Mr. Cutler's remarks, if he heard them correctly. He quite agreed with one point mentioned at the commencement of the paper: "Presuming that, when external framework is adopted, it is not advisable to reduce the guide-framing below the upper or inner lift in the position in which the gasholder bell is fully inflated." He was an advocate for entirely abolishing guide-framing; but when it came to a partial abolition, when they had the lower portion of the holder guided in the ordinary way by columns, he desired to put it on record that he did not think it advisable to let more than one lift out of three go free above the guide-framing. He was prepared to let three, four, five, or any number, go free, if he started it from the base resting on the tank; but when it came to guiding the lower lifts between columns, he could never advise that more than the top lift of all should be allowed to go entirely free. Altogether, the paper would be very valuable; but it could not be expected that any number of gentlemen, however well versed they might be in mathematical matters, could, at a moment's notice, discuss minutely, and in its various details, a communication of this character with that freedom which could only come after careful perusal.

Mr. W. H. Y. Webber expressed his admiration of the thorough way in which Mr. Walmisley had opened out this subject. As had just been said, it was not a paper to be discussed off-hand; in fact, he should rather prefer to describe it as a lecture. Looking at it from that point of view, it was a worthy pendant to the one they had the previous day. He wished to express the sense of indebtedness under which everyone who was likely to take any special interest in the problems of gasholders and their construction must feel to Mr. Walmisley, as well as to Mr. Cripps and other gentlemen, who had done so much to put the study of these matters on a rational and intelligible foundation. He thought gasholders would continue to be guided by external framing for a good many years yet to come, whatever experiments might in future be made in other directions. This being so, it was in the highest degree desirable that guide-framing should be studied rationally; that, instead of merely copying old examples when a new holder had to be erected of a few feet greater diameter than the one of which it took the place, they should not merely put in a few more standards, or, when it was carried up a trifle higher, put in more scantling here and there, and a little bit of a fantastical arrangement of girder. They were getting to a time now when these matters should really be studied scientifically, and not merely as a matter of addition and copying, or even of fancy. Intuition had been referred to in the President's address as a wonderful thing; and so it was. But if there was any field in which intuition was to be suspected and shunned more than another, it was in works of construction with iron and steel. In following Mr. Walmisley's paper, they would all see how the curse (for it was little less) of intuition could be avoided. Not only was the paper valuable for what it told them, but it was even more so, especially to young members of the profession, for the method it disclosed. It showed how formulæ were put together. It was a great thing when a student was able to understand and work formulæ reliably and well; but there was a further point to which the attention of the student should be directed, which was not to take his formulæ in the same way as he took pills. Molesworth was very handy; but they should not use Molesworth, or Cripps, or Walmisley, or whoever it might be, as an authority which could not be questioned. Whoever used a formula ought to understand how it was constructed. This was really engineering, not dipping into Molesworth or anybody else for formulæ supposed to be applicable to certain problems, and putting the equivalents to the expressions, and working them out. That was not engineering at all. He could not sit down without refering to the wise remark Mr. Walmisley had made about the importance of "tendency" in all problems of gasholder construction. It struck him many years ago that there was a good deal of "tendency" to do various things about a gasholder. It was a moving, unstable, almost a living body; and it had tendencies to do all sorts of things—fall down, twist, buckle itself, and get out of shape, &c. All these tendencies had to be provided for and circumvented. If they could only check them, the holder would become a manageable thing; but once let the "tendency" run away with it, and nothing on earth would keep it safe. There was a golden rule in working out gasholders as with everything else—and, although very simple, it was astonishing how often it was infringed—viz., the old rule that "the strength of a chain was no greater than that of its weakest link." This often struck him on looking at examples of gasholder construction. He had seen elaborate columns and standards just "tacked," comparatively, into the soil; or a wonderful arrangement of girders going round the top of the standards, tacked in its place by a few small bolts. This was a very common weakness. Again, he had seen elaborately-built holders and guiding framework, with rollers and carriages which were absolutely futile for bearing the stresses they had to transmit. The rule as to the strength of a chain was almost the first, second, third, and last principle to be borne in mind when one was dealing with problems of engineering construction.

Mr. G. Anderson (London) said the paper was very valuable, and would be better appreciated when it had been studied quietly. It struck him, however, that, together with others on the same subject, and with the discussions which had taken place in the Journal of Gas Lighting and elsewhere on the same question, it had perhaps raised an opinion in the minds of some people that there was a great deal of ambiguity about the existing mode of guiding gasholders; and seeing that holders had sometimes tumbled down, it might have been thought that they had done so in consequence of the weakness of the standards. He had tried his best to ascertain the causes which led to the destruction of gasholders; and he did not remember one instance in which it could be assigned to the weakness of the standards. He had been able to attribute it to their not having been erected in a truly mathematical manner. It had been either the fault of the contractor, in not erecting the standards perpendicularly in the first place, or the result of some exigencies of the position having afterwards put them out of the vertical, which had caused the failure in the cases into which he had been able to inquire. When he first began to think about gasholders, some forty years ago, he was bold enough to deviate from many things he saw around him; and one of these deviations was that he did not consider that a circular column, such as one saw placed in front of a church to support the pediment of a Greek temple, was the proper thing to employ for a gasholder. These things were properly used by the ancient Greeks to support a weight on the top. With a gasholder, however, one had to support a lateral weight; and therefore he did not see that it was sensible to build columns to guide a holder in the same way as those which had to support a weight on the top. He, therefore, very early introduced what might be called girders on end; and he remembered well how much they were criticized at the time, and how everybody said that the holder at the old Great Central Gas-Works would tumble down. They had all the forces and talents against them in Parliament, telling them that everything was too cheaply got up. Being then only a youngster, he, of course, felt anxious, although he did not doubt that there was strength enough; and when the first two girders were up (the intention being to have four in a quadrangle, all bound together), and a strong storm of wind came on, he was anxious to see how they behaved. As they were made of open lattice-work, he climbed to the top—a height of 50 feet—and stood there grasping the standards, and looking at the effect while the storm was on. He was glad to say everything remained perfectly rigid. This convinced him that there was quite strength enough; and this had since been proved, for the gasholders were now working in the same guiding as that in which they stood in 1850 or 1851. He had frequently,

on examining gasholders, found that the standards or columns were not perpendicular. If they leant in, great pressure must be brought to bear as the holder rose; if they fell back, the guides left the standards altogether, and the holder was entirely without support. If a storm of wind happened to come on just at that time, the wheels at the top having lost their support, all the stress was thrown on one or two others, which were not able to bear it. When the wheel left the top standard, a lurch took place which might break something. He remembered seeing a gasholder 50 feet in diameter in a rather exposed position, and all the support it had was a number of braced bars—3-inch round rods set perpendicularly, with trusses behind them, which could be screwed up. It was exceedingly light; but the holder never fell. Then he remembered, at the British Gaslight Company's works, some holders which had columns about 6 inches in diameter—round, like pipes. They went up to a great height, and looked weak; but they stood very well the last time he saw them. If the standards were perpendicular both sideways and frontways, and the carriages were of sufficient strength to bear the resistance they had to overcome, there was very little fear of gasholders going over, even with light guide-framing, provided it was correctly constructed.

Mr. Walmisley, in reply, thanked the members for the kind way in which they had received his paper on the somewhat abstruse subject dealt with, and particularly those gentlemen who had greatly tended to complete his remarks by the practical statements they had made. His efforts had not been to bring forward anything novel, but to put before the meeting investigations which he had found of use to himself, and thought probably would be interesting for discussion. It was at the President's request that he read his paper. There was everything to be said in favour of the lattice developed form of standard, not only from its power of resisting the strains brought upon it, but also from its convenience in many other ways. Mr. Anderson had referred to his experience in climbing up such a standard; and, of course, if an engineer could climb up it, a man could easily do so to paint it. It was a wonderful saving in the cost of scaffolding outside for painting a gasholder when planks could be stretched from the lattice-bars of one standard to those of another.

Mr. Gadd's Paper on Cantilevers and Cantilever Gasholders.

Mr. Walmisley said he had not had the advantage of seeing the paper which was read before the Manchester District Institution, to which Mr. Gadd had alluded; and in order to duly appreciate the value of this paper, he should like, not being a gas engineer, to put a few questions to Mr. Gadd. At first sight, he did not quite see the object of it. He could not, of course, deny many of the arguments put forward by the author. They were as simple as possible, and the points were brought out with perfect clearness; but he wanted to see something of the application of them. Was he to conclude from fig. 1 that Mr. Gadd would recommend a square section for a gasholder, and that the bracing was to be at that angle? or was he to conclude that the bracing would be better placed if at an angle, as shown in fig. 4? Mr. Gadd's paper would have been more valuable if he had illustrated his remarks by a section of the usual proportions—say one-fifth or one-seventh of the diameter—instead of emplying a square section.

Mr. S. Cutler (London) thought no one would dispute the propositions Mr. Gadd put forward; but what they were all the more interested in learning was how the invention could be successfully applied to the working of gasholders. It did not seem to him that the paper referred to this, the important element in the question. It was impossible to get rid of the force which, in varying degrees more or less severe, was constantly being exerted on a gasholder—viz., the force of the wind. Mr. Gadd proposed to avoid the use of all guide-framing, together with the guide-wheels at the top and bottom as usually provided, and to depend for the stability of the holder on the rollers, fixed at the bottom only, and working in the spiral guides. He (Mr. Cutler) always endeavoured to keep an open mind on these matters; and, in common probably with others similarly interested, he had been looking out for some safe and reliable way of avoiding or cheapening the expensive part of a gasholder—viz., the guide-framing. But he certainly was not yet converted to Mr. Gadd's idea. It did not seem to him that he could successfully resist the forces of the wind, such as were sometimes experienced in this country, in the way he proposed. But even if this could be done, it would be exceedingly undesirable to depend on appliances completely concealed from view. Those of Mr. Gadd were below the water-line, and could never be got at or examined, or any derangement made good. This always seemed to him (Mr. Cutler) to be the most serious practical objection to apparatus which was so extremely important. But supposing a holder to be guided on Mr. Gadd's plan, why did it not overturn when acted upon by the wind? It must be "locked" in some way; and therefore the weight of the vessel must be more or less supported. If this were so, the pressure of the weight of the holder on the gas inside it must be to a corresponding extent removed; and he did not see how the holder could go down or up at the same moment that it was resisting the wind. Of course, moderate winds would operate to a moderate extent on comparatively small gasholders; but let them keep in mind what the wind in this country could sometimes do, and consider the probable effect under such circumstances. His (Mr. Cutler's) idea of a gasholder was that it should be free to rise and fall at all times; and if the only reason why it did not blow over was because it was held up, and the weight more or less supported, he did not see how it could act properly as a gasholder. Herein there was certainly a difficulty which seemed to him to be insurmountable.

Mr. Gadd said he could quite appreciate the difficulty Mr. Walmisley was in, being utterly unacquainted with the previous history of the papers and discussions connected with this matter. The sole object of the present paper was to put straight, in a simple form, some small theoretical considerations which he conceived had gone a little astray. It was not intended in any way to be a detailed practical application of those principles to the special stresses. He was glad to find Mr. Walmisley agreed with the simple mechanical principles he had mentioned, from which, of course, he could hardly imagine anyone could differ. With regard to Mr. Cutler's remarks, of course they knew well enough, as a matter of actual fact, that a tolerably large number of gasholders were constructed without guide-framing; and these actually did resist wind pressure. Therefore, they had merely to deal with the question of how it was they did it. The guides which carried the holder were placed at an angle. This being so, if one considered the holder as subject to parallel forces forming an upsetting couple, the one side had a tendency to go down or to turn in some direction, and the other side to go up. But with spiral guides put round a circle, it would be found that any two guides on opposite sides of the holder would incline in an exactly contrary direction to one another; and thus any tendency to lower on one side was resisted by a tendency to lift on the other side. If this force was considered as being converted into a horizontal force, there was then a locking action, as Mr. Cutler had perfectly described, and that action was the whole thing. There was the safety resistance, and the whole of the gasholder became for the moment a perfectly rigid column. He quite appreciated the difficulty to which Mr. Cutler had referred. It was one he had in his own mind, theoretically, before he made his experiments; and it would probably occur to all practical engineers. The difficulty was this: If the holder were locked fast, it was the same thing as if it were screwed to guides all round. For security, this was all very well. But the question of practical working came in; and that was what Mr. Cutler had in his mind. If the holder were locked fast, there might perhaps be an interference with its working up and down. Of course, this occurred to him (Mr. Gadd) at first; and he felt that theory required to be supplemented by some practical experiment. He therefore proceeded to make one on a small scale; and he carried out a great number of minor ones to settle the question. He found that even in a small experimental holder, only 12 inches in diameter, he could never make the difficulty an appreciable one; and if it could not be made appreciable in a holder of that diameter, it could not in one of 12 feet, much less of 50 feet or more. In a holder there was a large volume of gas, which had its own elasticity, so to speak—it was under pressure. If they could imagine the holder being locked fast for two or

three seconds, or even for five minutes (and he had calculated it out to ten minutes), and if they withdrew gas from a holder, say, 50 feet in diameter and 20 feet high for five minutes, it ought to reduce the pressure; but they would be astonished to find that really it did not do so to any practical extent. Something else came in, as they could not keep the holder in one position with the gas going out for five minutes any more than they could an ordinary one. When a gale was blowing on the side of an ordinary holder, it was jammed against the opposite side; and if the gale was imagined to be strong enough, it would hold it there, and it did resist its falling to some extent. But the moment they took out some of the gas by excess of pressure, they were then reducing the power of keeping the holder up. As a consequence, the increased weight began to take effect, and this overcame the friction; so that, as a matter of practice, although in a measure locked, it was only locked within the margin of the pressure of the gas, and this did not really interfere materially with its working up and down.

Mr. CUTLER remarked that this depended on the force of the wind.

Mr. GADD said he admitted that at once. If one could suppose a gale blowing with such a force as to drive a solid body up against a wall, and hold it there, such a wind would interfere practically with the working of a holder momentarily, but only momentarily, because the gale did not blow with any steady pressure. It blew in puffs and gusts; and the moment there was the slighest relaxation, it would find its new level and be ready for the next gust. In practice, with the most delicate gauges put on the holder (and he should be glad to receive for experiment any delicate gauge anyone could provide), they did not record a fraction of 0·1; in fact, not anything that could be read as interfering with the pressure, not even under the heaviest gales to which they had been subjected. If Mr. Cutler, or any other gentleman, would be kind enough to make as many experiments and tests as he thought proper, it would be found that, although this matter appeared to constitute a difficulty theoretically, it did not do so in the slightest degree in practice. As to the question of the rollers being out of sight, or not readily accessible, there was only one row of rollers at the bottom of the holder; and those could be made "get-at-able" with the greatest ease. If desired, it was quite feasible to reverse the order of things—putting the guides on the holder, and the rollers on the tank or the cup. This was provided for, though he had not yet made a holder of that character. He had been influenced more by appearances than anything else, as he thought a plain holder looked better than one having the ribbed guides on the outside. If the guides were put outside, however, everything would be above-board. But, independently of that, this difficulty did not trouble him. He did not look on rollers, in this method, as actual working arrangements, for the simple reason that it was quite immaterial whether they were rollers or solid blocks. It was only in deference to the expressions of opinion put forward by gentlemen connected with the Institute that he had not substituted solid blocks or rubbing-pieces for rollers; for he did not think it was of the slightest moment whether the rollers turned or stood still. He had tested this thoroughly by experiment; and as soon as gentlemen had lost a little of their conservatism on the subject, he should be pleased to substitute solid blocks bolted to the side of the holder.

Mr. WALMISLEY said he should like Mr. Gadd to answer the question whether by fig. 4 in his paper he meant to recommend the bracing which was there shown as preferable to that of fig. 1.

Mr. GADD said the figure to which Mr. Walmisley had referred was not directed to the bracing at all; it was merely the question of the direction of the force. He was not speaking of framing.

The PRESIDENT said they were under obligation to Mr. Gadd for his paper. He need hardly say that the author was too practically acquainted with the construction of gasholders not to be able to defend the views put forward in his paper; but, of course, it was understood that the Institute was not responsible either for the papers or the views submitted. In fact, the putting forward of views with which the members were not in accord often served much better the object of eliciting useful discussion than papers which simply described ideas with which they were all familiar.

PAPERS READ AT THE MEETING.

(*Concluded from p.* 23.)

CANTILEVERS AND CANTILEVER GASHOLDERS.

By WILLIAM GADD, of Manchester.

In June, 1890, I read a paper at the meeting of The Gas Institute on the subject of a cantilever gasholder, the contents of which paper provoked a considerable amount of discussion. Unlike most controversies, this did not result in the truth being brought out with perfect clearness. On the contrary, various matters were apparently left in some degree of obscurity or doubt. As the number of cantilever gasholders has increased considerably since then, and is likely to grow much greater in the future, it may be desirable to put into as simple a form as possible some of the mechanical principles involved in a secured cantilever subjected to a horizontal load or strain, like unto wind pressure.

In doing this, I shall be compelled to reiterate some facts, as universal and scientific, which were called in question during the discussion alluded to. I am desirous of making my words as simple as possible, so that the meaning of every part of this paper may be followed with perfect clearness, to which end I shall avoid the use of all signs, other than arrow-heads, for showing the direction of forces, while the lengths of the lines in the figures will be employed to represent the magnitudes of the same.

A cantilever gasholder is very far from being a rigid structure; and, therefore, its degree of elasticity has to receive a fair consideration. But it is advantageous to assume, in a preliminary investigation, a perfectly rigid structure. Therefore, let A B C D, in fig. 1, be a square rigid plane without weight, capable of turning on the point D, and acted upon at B by a single force equal to the line B A. Then a vertical resistance will have to be applied at C, equal to B A or B C. Also another resistance, equal in direction and dimension to the line D B, will have to be applied to the figure at D, all acting on a particle at B, to enable the body to be held in equilibrium. Hence we obtain the three lines of force which form the conventional and well understood triangle of forces. There are two important observations to make at this juncture, which possibly are sometimes overlooked, although they are so very simple: 1. The only force (under these conditions) developed at C, is a *vertical* force. 2. The only force (under the same conditions) developed at D, is a *diagonal* one.

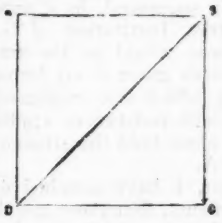


FIG. 1.

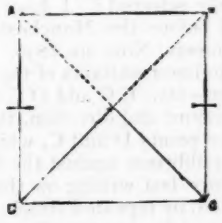


FIG. 2.

Now we may, if requisite for purposes of calculation or comparison, express these forces in terms of any other forces which are mechanically equivalent. For instance, we may say that, as the forces B A and B C together equal in effect the force D B, so also A D and C D are equivalent to D B; and that B A and B C balance D A and D C, the latter combination giving us a quadrangle of forces. Nevertheless, although these various combinations are mechanically equivalent, or equal in effect to one another, they are—like the geometrical lines representing them—not the same. What is really meant is that we may substitute any of these equivalents without disturbing the equilibrium of the plane.

Now the sole reason why we have, in the case shown, a vertical resistance at C, and a diagonal resistance at D, is because D is arranged to absorb all the horizontal reaction, leaving C to take up the remainder of the total generated resistance, which is vertical in direction. Hence it follows that the *directions* of the resistances engendered depend entirely upon *where*, and in *what manner*, the resistance points are placed. If, therefore, we add a second resistance at C in a diagonal direction, and another at D in a vertical direction, it is most palpable that these new

resistances will equally subtract from the two primary ones, and the result will be half the total vertical added to half the total diagonal resistances on each side—making the forces at C and D equal to each other, both in their direction and amounts.

This may be expressed as $\frac{B C}{2}$ and $\frac{A C}{2}$, at point C; and $\frac{D B}{2}$ and $\frac{D A}{2}$ at point D in fig. 2, from which it is clear that point D has given up half its diagonal resistance to point C, and point C has given in exchange half its vertical resistance to point D, and the two are equalized.

This was the distribution of the resistances given in my former paper.

Substitutionary pairs of resistances were proposed—viz., B C and D C on one side, and D A on the other, as in fig. 3. These, of course, if applied to the points D and C, would keep the structure in equilibrium against the force B A, as they are mechanical equivalents of the other forces shown. But it will be seen that by this device the whole of the diagonal resistance is *removed*, or cancelled out. As a matter of fact, this particular distribution of forces would be brought about in a cantilever gasholder constructed so as to be held by vertical flexible supports.

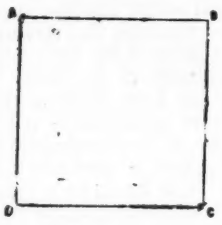


FIG. 3.

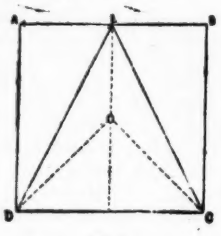


FIG. 4.

In securing a cantilever at the base, we must do one of two things—either we *select* the directions in which we desire to resist the load, or secure the cantilever in such a manner that it may select its own directions of resistance. This latter action will occur if we so secure each point as to be prepared against possible strain in *every* direction—a course which, in the case of a gasholder, would appear the most advisable.

If this is done, in our example, so that points C and D in fig. 4 are prepared to resist in any and every direction, when a force B A is in operation, the question may be asked, What are the directions and amounts of the resistances *actually* selected? I have already suggested, in a paper read before the Manchester District Institution of Gas Engineers, Nov. 29, 1890, that these would be the final single-line resultants of the two forces given in my former paper—viz., E C and D E in fig. 4, which lines represent, in amount and direction, the two *single* resistances applied at the points D and C, which will alone hold the structure in equilibrium against the force B A.

Since last writing on the subject, I have conclusively proved, by repeated simple experiments, that these are the two resistances *actually* generated in a cantilever plane which is completely secured at *both* points, D and C, and thus allowed to make its own final selection of direction of resistance.

It may here be incidentally observed that the line E C is alike the resultant reaction of the components B E and C B, as of the other components C O and O E; proving most conclusively that these two pairs of forces are exactly equivalent. The same thing may be proved by actual weighing of the resistants, as explained and accomplished by me before the Manchester District Institution.

If fig. 4 is examined, we shall see that the three forces B A, D E, and E C, all pass through one point; or in other words, they act on a particle at E. But in cantilevers subjected to wind pressure, the load is a distributed one over the whole face of B C; and, therefore, we have any number of points at which converging lines of force act along the whole length of the line E F. This distributed load may properly be considered as all taking effect along the line G H of fig. 5, as a single resultant load, of an equivalent value to B A, whence by construction we see the developed resultants O C and D O along with the force G H, acting at the point O.

Of course, in the conventional triangle with which we started (fig. 1), the points C and D are *unequally*

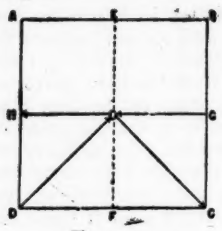


FIG. 5.

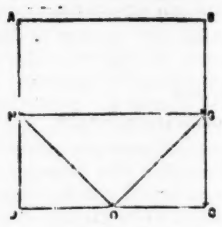


FIG. 6.

resisted both in amount and direction. But that conventional triangle is perhaps but seldom illustrated in actual structures, valuable as it is for purposes of investigation and calculation.

It has been suggested that the structure should be treated as being subjected on each side to a vertical resistance alone, while turning on the point O, as in fig. 6. This would, of course, necessitate the diagonal resultants—viz., H O and O G, to be both concentrated on the point or axis O, in the directions shown; and thus the resisting points C and D would have to be so arranged as to be entirely free from constraint or resistance except in a *vertical* direction.

These conditions, however, form no part of the actual original problem; and, indeed, they could only be achieved by adopting some kind of resisting axis capable of changing its position, so as to allow the structure to turn on such an axis in any direction, when submitted to forces acting in varying planes, as is the case with the wind, and in such manner as to cause the point O to *always* absorb *all* the horizontal reaction. This is probably an impossible practical achievement. We may, therefore, dismiss the suggestion as one only calculated to mislead.

Having considered the results of securing the *two* extremities of the base of a rigid square cantilever plane, when under lateral wind pressure, and the direction and amount of the developed resistances at those two points, it may be advantageous to inquire how these resistances are further divided when more than two points of resistance are employed along the base line of a single cantilever plane, and also when arranged round the base of a circular cantilever. In my former paper, I hypothetically assumed that the secured points round the circle of the cantilever gasholder under discussion might take an equal share of the total load as their maximum resistance. I did this to avoid the rather intricate investigation of the amount of variation due to the two facts, that the gasholder was not a rigid structure—but, on the contrary, fairly elastic—and that there was a certain amount of *play* at each point of resistance. Otherwise, had the structure been a purely theoretical one (that is to say, perfectly or even practically rigid), and there had been no play whatever at the secured points, I should have made no reservation at all, as in such case—with the arrangement of the secured points shown—they would each take up an equal part of the resistance. I am aware it has been suggested that the extremes of a number of secured points at the base of a cantilever take the greatest load, and that as the others approach towards the central line or diameter of the circle, they become gradually less loaded. But the reasons given for this are inapplicable, and appear to involve a misapprehension.

As the problem is one of statics and not of dynamics, there should be no more mystery or difficulty regarding the loaded base of a cantilever than regarding loaded beams. If we apply the theory of "moments" to an investigation of the distribution of a load over various supports in one plane, we may take our moments around an axis through the centre of a load, or around any point or axis, real or imaginary, which lies outside the area acted upon by the given load or pressure. For instance, if we support a beam at each end, and place a load at the centre, or apply a distributed load thereon, we know that each support will take half the total resistance, as the sum of the moments on one side of the centre of force equals that on the other. Now, it is quite immaterial whether one end of our beam is supported by a fixed resistance; by a turning axis; or merely held in equilibrium by another equal force producing a neutral condition at that point—the actual application of load is in all cases the same. It is perfectly true that any given resistance, as demonstrated by the lever, is most *effective* at the greatest distance

from a turning point; but this is the in erse or opposite of the suggestion alluded to.

FIG. 7.

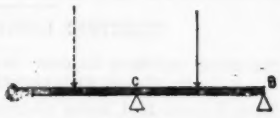


FIG. 8.

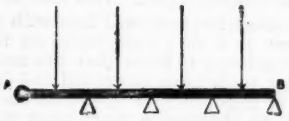


FIG. 9.

If we take a simple lever arm A B, as in fig. 7, turning on a fixed axis A, and suppose it to be loaded at the centre, as the equivalent of a distributed load, we shall have half the load carried by the support at B, and the other half carried by the axis at A. But if we introduce another support at C, as in fig. 8, and apply the equivalent of a distributed load over B C solely, as shown by the arrow, we simply divide our load equally between B and C; and A will be relieved from downward pressure altogether, unless we take into account a like load to be applied between A and C, in which case C will carry a double portion of the total, and the extreme points at A and B will have to support a less, instead of a greater pressure. In like manner, if we place a number of supports at equal distances along the lever arm subjected to a distributed load, we find, as in fig. 9, that each will take up, assuming accurate adjustment, an equal portion thereof, excepting the two extremes A and B; and these will only carry half the weight of any one of the others.

I will add, parenthetically, that with a very rigid beam or arm, it may be impossible to adjust these intermediate supports, arranged all in one plane, with sufficient accuracy to ensure the exact equal division of the load, and thus they become practically indeterminate quantities, although theoretically otherwise. But they can be assumed even practically determinate when the beam or arm is considered as comparatively flexible. This difficulty, however, does not arise in the case of a circular structure provided with supports arranged in different planes, as in the problem under consideration.

In the base of a structure like a circular gasholder, where the resistances are not all in one plane, and where, at first sight, there might perhaps appear to be a difference of conditions arising out of the seemingly varying forms of the areas of resistance to the load, nevertheless the same ordinary laws of mechanics most assuredly apply.

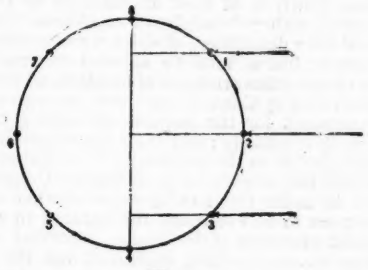


FIG. 10.

Let fig. 10 be a plan view of a circular structure, of uniform height, and secured at the base at eight equidistant points. Then let the two halves of the circular area be subjected to opposing resultant loads or pressures on each half—which, for simplicity, we may assume to be solely vertical. Now in an inquiry as to the share of resistance to the total pressure the various points round the circle will take, we may either proceed by (*a*) considering the totality of pressure as uniformly distributed over the whole area of the semi-octagon, as it undoubtedly is; (*b*) by considering it distributed solely over specific points enclosing special areas; (*c*) by directly applying the theory of moments; or (*d*) by considering the forces as acting in separate planes passing through the various points under investigation. The results from all these methods exactly agree—that is to say, each point absorbs an equal share of the particular pressure.

To deal with the last-named method first, we must remember that the moment of force at any point, taken round any axis, is the power applied at that point multiplied into the distance from such axis. It is apparent that if the initial powers applied through the different planes are all equal, we may take them as unity, when the mere measured bases of these planes will inversely give the proportionate pressure at each point. But if the initial powers vary, we shall be utterly misled by neglecting to multiply the distances by their respective powers, and be betrayed into assuming the very thing that we are desiring to prove.

The force of the wind may be taken, when applied to a plane surface, as of uniform effectiveness at every point of the plane; whereas its effective force or power upon the face of a cylindrical body varies from the maximum (or *unity*) through the central plane over point 2, down to *nothing* at the diametrical extremes over points 4 and 8. Hence if we take the effective initial wind power over point 2 as unity, the effective power over points 1 and 3 will each be of the value of $\frac{1}{\sqrt{2}}$ or a little over 0·7. That is to say, the effective power applied through any plane, passing vertically through any point on the circle, is precisely measured by the shortened lever arm taking the resistance at that point.

Hence if we apply these *effective* powers at the edge of each separate plane, at any uniform height—say, at 20 feet

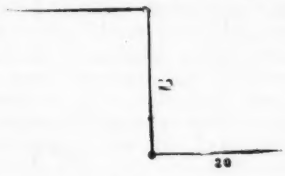


FIG. 11.

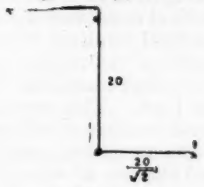


FIG. 12.

high—the proportionate value of the resultant pressure, at 20 feet radius, on point 2 will be

$$\frac{\text{Height} \times \text{power}}{\text{Length of resisting arm}} = \frac{20 \times 1}{20} = 1,$$

as shown by fig. 11; while the proportionate value of the resultant pressure on points 1 and 3 respectively, will be

$$\frac{20 \times \frac{1}{\sqrt{2}}}{\frac{20}{\sqrt{2}}} = 1,$$

as represented by fig. 12. That is to say, the pressures on each of these points will be equal.

To consider the method of directly applying the theory of moments, we will suppose the wind force acting with horizontal pressure on the diametrical section of the structure, and divided by 2 to allow for the cylindrical shape—thus producing an upsetting couple. This, of course, must be resisted by a reacting couple of equal moment. By this method, we can only determine the proportionate magnitude of the forces composing this reacting couple by finding the length of the lever arm. At present we have, so to speak, in figs. 13 and 14, three and four lever arms respectively, which are of different lengths, and act in combination.

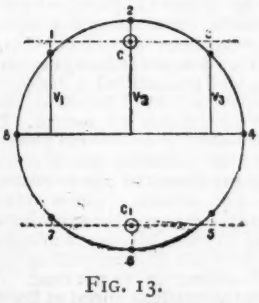


FIG. 13.

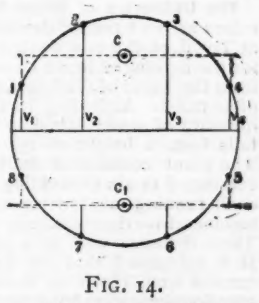


FIG. 14.

What we really require to accomplish, is to substitute, in each case, a single equivalent lever arm—an operation which constitutes a mechanical problem of no greater profundity than the common feat of striking an average. We simply add the various lengths together, and divide their sum by the number of lengths. Let 1, 2, 3, &c., represent the points of support, and V_1, V_2, V_3, &c., their distances from the

turning axis. Then the *true* distance apart of the centres of thrust and lift C and C^1, will be for fig. 13, $2 \times \frac{V_1 + V_2 + V_3}{3}$ = in a structure of 60 feet diameter, 48·142 feet; and for fig. 14, $2 \times \frac{V_1 + V_2 + V_3 + V_4}{4}$ = 39·198 feet on the same scale.

Then if we take moments round these centres of load, we shall see that in each case the moment at one point exactly equals the moment at every other, because the sum of the moments on one side of the centre of force equals that on the other, as will be readily seen.

Next, we may consider the distributed pressure as taking effect exclusively over the specific horizontal area formed by the three points. We all know that the centre of an uniform pressure over a triangular plane surface is at one-third of the perpendicular, which exactly coincides with the point C in fig. 13, as obtained by the previous method; and that the three extreme points of such triangle will each resist an equal share of the total pressure.

Finally, if we consider any other figure bounded by four points, or the semi-octagon, bounded by five points, the fact of there being a distributed pressure uniform over the area considered, the centre of such pressure, will be coincident with the centre of balance of the points, and will thus act equally on any number of points arranged around the circle symmetrically. Indeed, if the vertical resultants were "like" instead of "unlike" forces, the final resultant of such parallel forces would fall in the centre of the circle, when it would be palpable to all that the points round the circle would take an equal share of the load. The *amount*, in any particular case, of these equal resistances will depend not only upon the dimensions of the structure, number of points of support in operation, and amount of wind pressure, taken as data, but also on the selection of the direction of the resistances—whether we arrange these as vertical and horizontal; vertical and diagonal; or single-line resistances in neither of these directions; or whether we consider the resistance as solely vertical.

In conclusion, the question of how far this equality of pressure will be modified by "play," or looseness of securement, in a practical structure like a gasholder, is a matter for more refined investigation. But one thing may at once be affirmed—viz., that if the amount of play at the points be not great, the elasticity of the structure will readily compensate for it; and the larger the structure, wherein the elasticity becomes very great, the more quickly is this compensation effected.

The Awards at the Crystal Palace Electrical Exhibition.—The awards of the Jurors at the above Exhibition have been published. Messrs. Crossley Bros., Limited, receive a diploma of honour; and Messrs. Siemens Bros. and Co., a diploma of honour and a gold medal. Among the recipients of silver medals are: Messrs. J. E. H. Andrew and Co., Limited; the Bristol Gas-Engine Company, Limited; the Campbell Gas-Engine Company, Limited; Messrs. Dick, Kerr, and Co., Limited; Messrs. F. and C. Osler and Co.; the Trent Gas-Engine Company, Limited; and Messrs. Woodhouse and Rawson United, Limited. Bronze medals have been awarded to the Capitaine Gas-Engine Company and the "Trusty" Engine Company.

The Utilization of Water Power for Electric Lighting.—Particulars are to hand of the inauguration, on Monday last week, at Tivoli, of the new works which have been carried out there for the lighting of Rome by electricity; the power being derived from the water of the famous falls, and transmitted a distance of 20 miles. According to the correspondent of *Industries*, the quantity of water taken is about 990 gallons per second. It falls from a height of 157 feet, developing 2400-horse power. The plant consists of six turbines of 300-horse power each, connected to six alternating current dynamos of 230 kilowatts, each running at 170 revolutions per minute. Three other turbines drive three continuous-current dynamos used as exciters. These dynamos work at a speed of 375 revolutions per minute. It is calculated that the loss of pressure in transmitting the current from Tivoli to Rome will amount to 20 per cent. A transformer station has been built in the neighbourhood of Porta Pia, where the pressure will be reduced from 5000 to 2000 volts. At the pressure of 2000 volts, the current passes through the main conductors; and at another transformer station situated near where the current is to be used, the pressure is reduced to 1000 volts. A part of the current derived from Tivoli is being used for lighting the streets of Rome by means of arc lamps. These are arranged in series, in groups of 40 lamps each, in order to avoid the double transformation required by incandescent lamps.

ESSAYS, COMMENTARIES, AND REVIEWS.

ELECTRIC LIGHTING MEMORANDA.

The Edison and Swan Dividend—The Piccadilly Mystery—The Lighting of the Thames Embankment—An Electrician's Lament.

THE Edison and Swan Company are going to pay a dividend after the rate of 7 per cent. upon the last year's working, with a back dividend at the same rate. This is news which the users of incandescent electric lamps will hear with mixed feelings. On the one hand, it is doubtless gratifying to friends of the electric lighting industry to learn that the monopolists of the incandescent lamp trade have succeeded in doing so well; but, on the other, it is impossible to ignore the fact that this has only been done by charging a fancy price for the articles in question. When the Edison and Swan Company's patent lapses, which it will now do after a period measurable by months, the price of the incandescent lamp will fall to 15d. or thereabouts. This is expected to make a considerable difference to the business of the central station companies, provided that the quality of the lamps does not fall with their cost, as to which grave fears are already being entertained and expressed. Some time ago a few users of incandescent lamps ventured to raise the inquiry as to whether the Edison and Swan Company were sending out trial parcels of cheap lamps, because those now offered for sale do not appear to be so good as the lamps of last year. No satisfactory answer has been given to the question; but we may reasonably doubt whether the makers would pursue such a suicidal policy as that indicated by their discontented customers. The truth of the matter appears to be that the incandescent lamp, however good, has lost its pristine charm in the eyes of users, who are consequently prepared to grumble with a means of lighting which, while not more perfect than other human productions, was absurdly overrated in its early days.

Really, our amiable contemporary the *Electrician* must pardon us for venturing to correct it in regard to a small but not wholly unimportant matter. In referring to the recent correspondence between the St. James's and Pall Mall Company and the Board of Trade on the subject of the mysterious incompatibility of the Piccadilly gas-meter and the electric light wires, of which mention was made in these columns last week, the *Electrician* remarks: "It is natural, and perhaps even desirable, that the gas journals should be for ever on the alert to criticize the proceedings of electric lighting companies; but if electrical journals were to devote a proportionate amount of space to the chronicling of small beer in the shape of gas accidents, they would have but little room for anything else." This is "all very fine and large," as some people would say; but the case is not exactly so. We have a shrewd suspicion that electricians are not wholly above making capital out of particular gas accidents, when these are serious enough to take the public attention; and our rivals certainly make a great parade, in a general way, of the supposed superior safety of electric lighting as compared with gas. With regard to the instance in point, however, it may surely be contended that a mysterious occurrence which was regarded as worthy of the particular attention of the Board of Trade might be noticed by observers of the struggle of electric lighting against gas in certain localities. We have no wish to fill our space, which is at least as valuable as that of any electrical journal, with "chronicles of small beer" in the shape of electricians' little difficulties, of which we hear enough and to spare every week; but we must be allowed to exercise a wise discretion as to the noteworthiness of incidents of the kind.

The London County Council have not yet agreed to spend the £10,000 required for the purpose of lighting the Victoria Embankment by electricity; but their hesitation does not proceed from antagonism to the proposal. It is rather due to an opposite motive; the scheme, as passed by the Committee, being referred back in order for it to be seen whether an arrangement can be come to for extending the lighting to the bridges. If this proposed extension of the lighting is carried out, not only will the outlay be considerably increased, but the question of river navigation will also come to the point again. The river Thames is difficult enough to navigate between bridges as it is; but when these are furnished with glaring arc lights, the eyes of pilots are so blinded as to render it almost impossible for them to do their duty. The only remedy is to screen off the backs of the lanterns; but this spoils the effect, which is unfortunate, for the lighting of ornamental quays and bridges should be decorative before everything.

The electricians are insatiable. A member of this interesting confraternity went to the Warwick Show of the Royal Agricultural Society, and came home in tears because he discovered the appalling fact that as yet "the application of electricity to agriculture does not exist." It is true that he found in the show-yard "a few dynamos, a few lamps running in broad daylight at unknown voltages, a few spasmodic arc lamps demonstrating the irregular motion of a gas-engine; but nowhere do we find the electric cow-milker, or the electric curd-depositor, or the electric seed-raiser, all of which will, no doubt, some day do for agriculture what the electric furnace has done in metallurgy, or the electrolytic bath has done for the metal refining." It is difficult for an impartial outsider to perceive the sense of this complaint, or the justification for this prophecy—the last

of a long and mournfully unfulfilled category. The cry that "there is nothing like leather," is heard everywhere; but why, in the name of all that is reasonable, should the most zealous electrician weep because there are a few matters which electricity does not touch? Gas engineers are just as "shoppy" in their way as electricians; but it is probable that the most enthusiastic of the band has his moments when it is a positive relief to his mind to know that there is no such thing as a gasholder within many miles of him. Let the electricians finish some of the things they have already in hand, and show their ability to make an honest living out of the undertakings to which they are committed, before they ape Alexander in sighing for more worlds to conquer. Then perhaps they may be able to take up the application of electricity to agriculture at the point where the late Sir W. Siemens left it.

COMMERCIAL LABORATORIES AND EXPERIMENTAL WORKS.

A FEW weeks ago an article appeared in *Industries* on "Commercial Laboratories." It advocated with much powerful argument the creation of a class of establishments which at present do not exist anywhere—specialized workshops, or factories, that is to say, where new departures in engineering, chemical industry, &c., might be tried upon a commercial scale before being put to the crucial test of practice in ordinary business. Reading what our contemporary had to say upon the general subject with the case of the gas industry in mind, we recognized, in much that was advanced, matter that might well have been reproduced in these columns. For example, it was postulated as an axiom that "few industries are so fully developed that there is no possibility of further progress." Certainly, that of gas manufacture and supply is not one of those which do not progress. On the other hand, it is equally true that progress is not the universal law of all industries; and in gas making there is undoubtedly a good deal of that kind of movement which is known in military drill as "marking time." As the article under notice admits, however, the introduction of improvements in industry frequently necessitates a large number of preparatory experiments, for which the ordinary conduct of many industries provides little facility. It consequently becomes a question, in some instances, whether the possible benefit to be derived from an improvement is such as to justify such an interference with the ordinary run of work as would be caused by an attempt to introduce it; and that manufacturer is not to be lightly condemned who concludes that his circumstances forbid his changing processes which answer his immediate purposes, for others which may possibly prove more advantageous, but will certainly upset his business until they become firmly established as matters of routine.

Still, is no improvement to be attempted because its introduction may be attended with some trouble? It would be deplorable if any such conclusion could be regarded as of general validity. It is a sufficient concession to the powers of antagonism in industrial matters if we admit the existence of conditions which render want of progress in some industrial establishments more or less excusable. Speaking of any industry generally, however, it is indisputably true that progress, growth, development, and change are indications of life; and that the reverse manifestations are symptomatic of impending paralysis and death. It cannot be said that the industrial and commercial world as a whole is averse to change; and the world of science is notoriously given over to mutation. It is said of a certain professor, now lost to science, that, when he took possession of his chair, he made a clean sweep from his library shelves of all text-books more than ten years old, in order that his pupils should not be exposed to the risk of having their minds contaminated with obsolete ideas. And how often, in the course of a year, do we see in the newspapers prospectuses of joint-stock adventures into previously untried arts and industrial undertakings?

The *desideratum* which the writer of the *Industries* article had in view was the same which has long engaged our attention; being nothing less than the union of scientific suggestion with industrial and commercial acuity. It cannot be said that this union is sufficiently ensured by current practice. What we do most frequently see is a forced connection between some vaunted result of laboratory or drawing-office work, and the investment market. Somebody brings out a taking scheme for which an experimental success is claimed; and the next step is the floating of a Company with an exaggerated capital ostensibly to "work the patent," but really to line the pockets of a gang of schemers who care nothing for the fortunes of the process so long as they can utilize its name as a means of securing "premiums."

It is difficult for those engaged in competitive trading to adopt the idea of commercial laboratories. Manufacturing chemists, and mechanical and electrical engineers, are continually thinking out and trying new things; but there has hitherto been no room in the British industrial system for any intermediate stage of application of an idea between the originator's private laboratory or study and the works. There is a good deal of truth in what our contemporary says upon this point: "If an English chemical manufacturer thinks of a new process, he rather scouts the idea of trying it in the laboratory first. With that sort of daring stupidity which sometimes passes for common sense, some would say, 'Try it properly on a commercial scale—laboratory tests are no guide;' and an expensive plant is put down, and put down incorrectly. The process does not work the first time; and as it would cost too much to put down another plant, the improvement is abandoned. Laboratory experiments alone would not have shown whether the process would work commercially; but they would have shown the best method of trying the process on a large scale, and would have saved a great deal of time and money." Of course, there are laboratories in most works where anything that can be called a chemical industry is carried on; but it is perfectly true, as alleged, that in the vast majority of instances these establishments are devoted to merely testing, the object of which is in effect, if not in name, to ensure that no departure is made from the established order of the business.

The reproach of laboratory work is that, even when it is directed to ascertain the data for new industrial developments, it is too often left in the hands of laboratory workers pure and simple, who can handle test-tubes and bottles very neatly, but have no acquaintance with the hard necessities of work upon the commercial scale. There are many problems, moreover, of the gravest importance, that are not susceptible of treatment in the laboratory, usually so-called. Among these must be classed the whole series of pyrological questions which have such a preponderating influence upon the economy of gas making, as of other industries. How can it be learnt from test-tubes and Bunsen burners what are the immediate and secondary effects of burning fuel in one way rather than in another?

The ideal manner of conducting researches which have, as it were, one avenue of approach opening from the laboratory and another from the works, is to operate in the laboratory in the spirit of the works' manager, and to inspire the latter with the devotion to science which should be supposed to rule the student in the laboratory. In manufactories based upon the principle of free competition in trade, this aim is, of course, difficult of attainment; but the importance of reorganizing laboratory work upon a commercial footing is being better understood in England than it was before the Germans robbed us of the trade in coal-tar residuals. In the gas industry, however, we have a peculiar manufacture, and one that may be regarded as specially adapted not only to the application of the idea of commercial laboratories, but also to an extension of this idea in the form of public experimental works, as was shadowed forth by Mr. James Helps, of Croydon, at a recent meeting of the Southern District Association. We do not desire to rob Mr. Helps of whatever credit may attach to the suggestion; but we take leave to explain it as follows: The members of every District Association of Gas Managers, or so many of them as can take part in the movement, whether for themselves or on behalf of their employers, should form a gas company, with a subscribed capital divided into shares, and registered in the usual way with such special Articles of Association as might be deemed necessary. This company should erect, or obtain control of, some gas undertaking of convenient size, which should be carried on in the first place as an ordinary gas-supplying concern, and secondly as a place for commercial experiment. There are many obvious advantages in such an arrangement. Most gas managers have on their works what they are pleased to call "experimental plant," which is chiefly used for testing coal; and some very remarkable tests are occasionally obtained in this way, if one may judge from the advertisements of certain gas-coal owners. All the trouble and responsibility of testing the varieties of coal commonly carbonized in the district would, in the arrangement suggested, be undertaken by the manager of the experimental works, whose tests would be carried out according to a routine prescribed by his directors, and on such a scale as they might deem satisfactory. Again, any novelty in the technology of gas-making that might be held worthy of attention in the district could be tried once for all; and the experimental manager, who would naturally be debarred from taking any personal interest in improvements brought under his official notice, would be enabled to report upon these without exhibiting the disturbing effect of the "personal equation." There is, indeed, ample work in every district of England for an experimental gas company, under proper guidance, to undertake in the general interest. Gas engineers in charge of particular works are but human; and frequently, when their interest has been aroused in a novel process towards which their first attitude was that of a judge, but which they have seen in course of promising development under their own eyes, they end with posing as strong partisans of the novelty. And, in the world of gas engineering, there is no little of an even lower kind of human nature, which carries its individual likes and dislikes into everything, and swears either *at* or *by* novelties, not according to their intrinsic merits, but according to the persons with whom they are connected. Moreover, while it is possible to sympathize with the manager of a gas-works who prefers "to look into matters for himself," as he would phrase it, there is reason with those who contend that a good works' manager and man of business is not necessarily also the best hand at an experiment, even supposing him to have time and means at his disposal for such a purpose. How difficult it often is for the master of a factory to arrive at the truth of a matter in which he is interested! If his men know him to be

in favour of a certain result, all his protestations of a wish to have a fair test will hardly avail to induce his people to return an unfavourable answer. Gas technology is full of instances of processes which were reported to answer in some works and not in others; and it should be the earnest desire of every gas engineer who has become responsible for any new departure in gas manufacture to have his own impressions respecting it corrected by independent evidence. It is not necessary, however, to elaborate the subject further. The suggestion is one that must be left to fructify in congenial soil; and we shall leave it for the present—engaging to return to the subject at a future date, if it shall appear desirable so to do.

Thomas Piggott and Co., Limited.—A Company under this title has just been registered, with a capital of £90,000, in £10 shares, to acquire the business of gas, water, and mechanical engineers now carried on by Messrs. Thomas Piggott and Co., of Birmingham. The first subscribers are Mr. G. H. Lloyd, Mr. S. S. Lloyd, Mr. A. L. Lloyd, Mr. C. F. Lloyd, Mr. H. Bewlay, Mr. G. A. Everitt, and Mr. N. Everitt.

Railway Carriage Lighting by Gas.—The Midland Railway Company have just commissioned Pintsch's Patent Lighting Company, Limited, to furnish three oil-gas works—one for Birmingham, one for Leeds, and one for Bradford—on their system; together with fittings for 886 coaches. This step seems to indicate that the electric lighting lately tried on the Company's trains has not proved so successful as was predicted.

Reduction of the Atomic Weight of Oxygen.—Writing to *Nature* recently, Mr. R. Lehfeldt, of Firth College, Sheffield, called attention to the summary of results of experiments on the atomic weight of oxygen lately given by Lord Rayleigh. In 1842, Dumas put the weight at 15·96; Regnault agreeing with him in 1845. In 1889, Lord Rayleigh gave it as 15·89; and now he puts it at 15·882. These figures show that the weight has been steadily decreasing for the last 50 years. Mr. Lehfeldt suggests, as an explanation of this, that the increased population of the world, together with the enormous consumption of coal, have caused great wear and tear of these atoms; so that they are now mostly deficient in weight. He thinks it would be desirable that a congress of chemists should be called to consider the question of providing for the renovation of the oxyge n supply.

The Transfer of the Southborough Gas-Works to the Local Board.—Under the powers conferred upon them by the Gas Company's Provisional Order of 1891 and their own Act of 1892, the Southborough Local Board have purchased the gas undertaking, in accordance with an award made by Messrs. Corbet Woodall and George Livesey, who were the Arbitrators—the amount of the award, exclusive of costs, being £8100. The works were handed over to the Local Authority on the 1st inst.; and already, under the advice of Mr. Woodall, they have commenced some extensive alterations. Arrangements have been made for the enlargement of the gasholder by Messrs. Ashmore, Benson, Pease, and Co., of Stockton-on-Tees; and a contract has been entered into with Messrs. R. and J. Dempster, of Newton Heath, Manchester, for additional purifiers. Mr. Woodall has also prepared plans for new works adjoining the South-Eastern Railway, about a mile from the old works, which will be closed when the new ones are completed in about two years' time.

The New Antiseptic.—A remarkable communication has been made by M. Trillat to the *Moniteur Scientifique* respecting the characteristics of the new antiseptic formic aldehyde, or formol. Chemically speaking, it has been generally admitted hitherto that the most powerful antiseptics occur among hydrocarbon derivatives of the aromatic series, or as salts of the metals; but the study of formol shows that the fatty series is capable of supplying antiseptic agents at least as powerful. Formol, in the state of aqueous solution, is a colourless, syrupy fluid, with a sharp odour, the effect of which upon the mucous membrane rapidly disappears. It is not very volatile. Its method of preparation illustrates the gain to be derived from the study of phenomena which at first sight appear to be mere fruitless curiosities. All works upon chemistry recount an experiment which consists in placing a spiral of platinum, previously heated, in contact with vapours of methylic alcohol emanating from an ordinary spirit lamp of which the flame has been blown out. The platinum remains incandescent; the phenomenon being due to the slow oxidation of the alcohol to aldehyde. Utilizing this principle, MM. Fischer and Low have been able to prepare small quantities of formic aldehyde by passing the vapour of methylic alcohol over red-hot platinum contained in a glass tube. The industrial apparatus differs from this laboratory arrangement, but has been developed from it. The sterilizing effects of the new antiseptic upon culture-fluids, sewage, &c., is very noteworthy; a dose of 0·0025 part sufficing to prevent alteration of composition during many weeks. Meat dipped in an aqueous solution of $\frac{1}{2\,5\,0}$ formol keeps from 10 to 20 days. The vapour disseminated from a 10 per cent. solution of formol prevents decomposition in a closed space; and meat wrapped in cloths treated with it keeps good in the warmest weather for a fortnight or more. All this is traceable to the study of the phenomenon of the incandescent platinum spirit-lamp which was commonly sold as a toy a few years ago.

NOTES.

The Oxidation of Nitrogen.

Bearing upon the so-called nitrogen-burning experiments of Professor Crookes, referred to last week, it may be recorded that Dr. V. Lepel has been investigating the phenomenon of the oxidation of nitrogen by electric sparks, and has contributed a paper upon the subject to the current number of the *Annalen der Physik und Chemie*. It is no new discovery that small quantities of nitric and nitrous acids and their ammonium salts are produced during the passage of high-tensional electrical discharges through moist air. Indeed, this result was a long time since noted as a possible obstacle to the adoption of electric arc lamps for the lighting of interiors. Dr. Lepel has endeavoured to obtain more precise information concerning the nature of the chemical reactions which occur in these circumstances, and the experimental conditions most favourable for increasing the amount of the combination of atmospheric nitrogen and oxygen. In other words, he seems to have been working at the electric arc as a means of producing nitric acid—treating the light as a bye-product. It was found that the continued passage of sparks through the same quantity of moist air does not result in the conversion of more and more of the atmospheric gases into oxidized products, because the difficulty arises that the passage of sparks through the gaseous oxides of nitrogen first formed decomposes them again into their constituents. Hence it is that in a closed space a limit is soon reached, beyond which the electrical discharge produces no more nitric acid. Dr. Lepel has made experiments with a slowly-moving atmosphere, under different conditions as to pressure, and with various types of spark discharge, with the result that he has already increased the amount of combination to 10 per cent. of the total quantity of air employed. Of particular interest are Dr. Lepel's remarks regarding the probable effects of the high-voltage experiments of which so much has recently been heard. He considers it not outside the region of possibility that by their aid there may be developed a new mode of producing nitric acid commercially from the atmospheric gases; thus rendering chemical industry independent of the natural nitrates as a source of nitric acid.

Bryan Donkin on Steam-Jackets.

Mr. Bryan Donkin, jun., has lately communicated to the columns of *Engineering* a preliminary statement respecting the results of some experiments he has made to determine the economic effects of steam-jacketing upon the three cylinders of a modern vertical triple-condensing engine, of marine type. Experiments were made, not only with boiler steam in all the jackets, but with different and decreasing pressures in the three jackets. The number of jackets used was varied; any one or any two being in action, or none at all. The results are instructive, and show an advantage of about 12 per cent. in favour of using the three-barrel jackets as compared with none. It is often a debateable point with engineers as to which cylinder does best with the jacket. These experiments settle the point; showing that the low-pressure cylinder jacket gives a much more advantageous result than either of the others, or nearly double the economical gain of both together. The high-pressure jacket alone gave 1¼ per cent., the intermediate jacket alone gave 2¼ per cent., and the low-pressure jacket alone gave 6¼ per cent. gain of feed water or steam as compared with the consumption without steam in any of the jackets, with the engine making about 57 revolutions per minute. With the three jackets working, it was also found that the steam became regularly drier as it passed through the cylinders. Exactly the reverse takes place without steam in any of the jackets. With all the jackets in action, the steam was nearly dry on leaving the low-pressure cylinder for the condenser. This is important, as little or no heat can be carried from the low-pressure cylinder walls to the condenser without water to convey it. The most economical result with boiler steam in all three jackets was 14·1 lbs. of steam per indicated horse power per hour, including jacket water, with 146 lbs. pressure and 61 revolutions. It was also shown to be more economical to use the full steam-boiler pressure in all three jackets.

Grouting and Stock-Ramming Foundations.

Mr. Walter R. Kinipple has lately been discoursing to the Royal Engineers at Chatham, and has also published several articles in *Engineering*, relating to certain methods of underpinning buildings with shaky foundations, and repairing leaks under tanks and wharf walls, &c. Mr. Kinipple's system is peculiarly suitable for the reinstating of foundations when the subsoil material has been disturbed by pumping for putting down neighbouring buildings. The simplest and most economical manner of procedure recommended by Mr. Kinipple is the resort to grouting and stock-ramming, whereby the foundations may be increased in width and depth and the strata underneath solidified. Should the shaky wall be founded on sand and gravel, all that is necessary is to put down a series of bore-holes of from 3 to 6 inches in diameter at intervals in the thickness of the wall, reaching down to the bottom, and going several inches into the ground beneath it. Pipes are then introduced into the holes, and thick neat Portland cement grout poured or forced down if necessary. This grout will find its way into all the cracks and faults existing in or underneath the wall, cementing

them up, and also cementing the bottom of the wall to the uppermost of the underlying strata. After an interval, a fresh series of bore-holes could be put down between the first, and deeper, the grout poured down through which would add at least another foundation course to the wall, and so on. If there is a leak or run of water through the places to be grouted, this must be temporarily stopped, or the cement will be washed away before it has time to set. If the stratum on which the shaky wall is founded is of clay, or of a clayey nature, then instead of forcing cement grout under the foundations, stock-ramming should be tried; bore-holes as before being made and lined with tubes, down which balls of clay, worked up with hydraulic lime, sand mixed with iron filings and sal-ammoniac, partly set neat cement, &c., are to be rammed by a monkey. This is recommended as a famous plan for stopping leaks.

COMMUNICATED ARTICLE.

SMALL GAS UNDERTAKINGS AND THE STATUTORY TESTING ARRANGEMENTS.

By Norton H. Humphrys, Assoc.M.Inst.C.E., F.C.S.

Now that the subject of the standard of light is under consideration, and it is an open secret that the days of the sperm candle are numbered, I would direct attention to one point that is likely to be lost sight of. Although the London Gas Companies only are represented on the Committee on Photometric Standards, the unit decided upon by that body may possibly be accepted as the law of the land. Perhaps the undertakings already authorized would not be forced to adopt the new unit. But it would be included in future Provisional Orders; and therefore the position of small statutory undertakings should not be overlooked. Since the passing of the Gas and Water Works Facilities Act, a large number of these have, very rightly, availed themselves of the opportunity of obtaining parliamentary protection; and the now familiar returns include concerns having capital as small as £2000, and a considerable number coming below the limit of £10,000. The position of these undertakings may be considered—first with reference to existing testing arrangements, and secondly, as to the effect of a change in the unit of light.

The cost of a photometer-room and apparatus is, in the first place, a serious item. And then there is the further question of a gas examiner, who, of course, will not render his services gratis. Any company or corporation having obtained an Order is liable, under the provision of the Act of 1871, to fit up a testing-room, with photometer, &c., as therein prescribed. But on account of the reasons mentioned above, many have omitted to furnish themselves with the testing apparatus. Of course, they are liable to be called upon by the consumers to do so; but in small towns the shareholders of the gas company are generally also members of the local board, and interested in all other public ventures. Even if the consumers were aware of the powers afforded by the Act, it is doubtful whether they would care to enforce them. In other cases, the photometrical apparatus has been provided; but there is no one in the district who is competent or experienced to act as gas examiner, and so an expert from a neighbouring town is engaged. It is a common thing in provincial towns for the gas engineer or the gas examiner to hold appointments of this kind for small places within a radius of about 20 miles. The terms of the agreement are that he shall attend at the testing-room a certain number of times in a year—perhaps four, perhaps twelve—and examine the gas in accordance with the parliamentary provisions. In other places, the local surveyor or borough engineer is appointed gas examiner. In many Acts of Parliament it is specified that the local authorities shall appoint such an officer. On inquiring of a borough surveyor once, in a town where this provision was in force, as to the whereabouts of the gas examiner, I was met by the reply: "I am the gas examiner; but I get no salary for it, and I take care that my services are equivalent to the pay." This plan of "contracting out of the Act" is not satisfactory; and it is evident that, apart from any question as to the accuracy of the parliamentary candle, there is room for some improvement in the way of simplifying and cheapening the standard testing apparatus. Even at the expense of a little sacrifice to accuracy, it would be well if some apparatus could be fixed upon, the cost of which would not be regarded as prohibitive; and the time occupied in making the test should at least not be longer than that at present required. A description of this could be substituted for the clauses relating to the photometer, in the cases of undertakings applying for less than £10,000 capital.

Now as to the effect of a new unit of light. Whatever may be said against the candle, as to not conforming to conditions, and so necessitating the taking of a second test, it occupies very little time in preparing. Since the introduction of the *in situ* balance, it is difficult to conceive a unit of light that could give less trouble in the way of getting ready for use. But assume for a moment that there was accepted a new standard which involved the provision of special apparatus in addition to the already expensive photometer, and also required that the examiner should attend at the testing-place some hours prior to the making of a test, in order to arrange about the preparation of the standard. The result would be an addition to the existing heavy burden on a small gas undertaking, or further inducement to the evading of the testing clauses.

With regard to large undertakings, the rental of which may perhaps represent a million sterling, it is quite necessary that some considerable expense should be incurred, if necessary, for securing an accurate test. But the insertion in the Provisional Orders relating to small undertakings, of clauses prescribing the use of apparatus that is costly in the first place, or that occupies the time of an expert for some hours at each using, simply tends towards making the testing of gas a dead letter. So that in prescribing a parliamentary unit of light, applicable to all statutory undertakings, the position of the small ones should not be overlooked. Whatever that of the large ones may be, they should be supplied with testing apparatus that is at any rate not more costly or expensive in working than that now recognized by law.

In the matter of introducing a new unit, there should be some degree of licence. It is possible that such a unit may involve considerable modification, if not the entire rejection, of existing apparatus. It would be a very hard thing if the conductors of gas undertakings, who had only recently provided a photometer, or incurred the expense of getting their apparatus stamped, should be called upon to bear further expenditure for new or additional testing instruments.

TECHNICAL RECORD.

THE ESTIMATION OF NITROGEN IN COAL GAS.

In the JOURNAL for the 28th ult. (p. 1238), we gave an abstract of a paper read before the Manchester Section of the Society of Chemical Industry by Mr. G. E. Davis, F.I.C., F.C.S., on "Testing the Illuminating Power of Coal Gas." On the same occasion, one dealing with the "Estimation of Nitrogen in Coal Gas" was read by Mr. C. H. NEW, of which the following are the principal portions. For the particulars given in regard to both communications, we are indebted to the *Journal* of the Society.

Mr. New commenced by remarking that, among the numerous methods suggested for the estimation of nitrogen in gas, there were none, to the best of his belief, which are not founded either upon the conversion of the nitrogen into ammonia, or the measurement of the volume of gas obtained after the removal of all other gases by absorption or other suitable means. Owing to the presence of appreciable quantities of cyanogen and basic compounds, the former method was not, he said, capable of being readily applied to the estimation of nitrogen; and therefore it was upon the latter—viz., that of ascertaining the volume of the residual gas—that the process he was about to describe was based. He then explained that the circumstances which created the need for a speedy and accurate method for the purpose named arose in connection with some experiments which were being conducted by his principal (Mr. G. E. Davis) in the Manchester Technical Laboratory, as to the quantity of air which it is advisable to introduce for the purpose of purifying coal gas. It was desirable to ascertain that the air so employed should not be used in unduly excessive proportions; and it was with this object that the method had been adopted, since by learning the quantity of nitrogen present both prior and subsequent to the introduction of the air, a very close approximation could be made of the bulk of air admitted.

The outline of the author's process consists in first removing the majority of the bases and certain hydrocarbons (such as benzene, xylene, &c.) by passing the gas through strong sulphuric acid, of 1·85 sp. gr., and converting the whole of the remaining hydrocarbons into carbon dioxide and water by passing the gas over red-hot copper oxide. The gases resulting from this treatment consist of carbon dioxide and nitrogen; so that the former may be absorbed by caustic soda, and the volume of the remaining nitrogen arrived at. The apparatus employed is not elaborate in character; the idea being that the manipulations should be as simple as is compatible with accuracy. It may be divided into five parts: (1) An apparatus for generating carbon dioxide. (2) A burette graduated to hold 100 c.c. of gas, fitted at the top with a three-way tap, and connected at its lower extremity with an aspirator. (3) A combustion-furnace containing a combustion-tube about 80 centimetres long, projecting some 10 or 12 centimetres beyond the furnace, and packed with coarse copper oxide to within 7 centimetres of the ends of the tubes, which are fitted with india-rubber bungs. Through each bung passes a piece of small-bore glass tubing; one being connected with a bottle of about 30 c.c. capacity containing strong sulphuric acid. (4) A receptacle, capable of holding 200 c.c., and graduated with a containing mark at 150 and 200 c.c., in which to collect the carbon dioxide and nitrogen resulting from the combustion of the gas. (5) A Hempel's gas apparatus.

The author gave further particulars of the apparatus (which was illustrated); and he stated that, although the process might possibly appear rather involved when detailed at length, it was

by no means so in practice, since the whole operation, from the passing of the carbon dioxide to the final reading of the nitrogen, could be accomplished in 30 minutes. He then proceeded as follows: Assuming the combustion-tube and copper oxide contained therein have been raised to a full red heat, during which operation a current of air has been aspirated through the tube by means of a Bunsen pump, so as to carry away any aqueous vapour which may be given off, and to ensure that none of the copper remains unoxidized, the air-pump is stopped, and the carbon dioxide generating apparatus is connected through the three-way tap with the combustion apparatus. A brisk current of carbon dioxide is then passed through the sulphuric acid absorber and combustion-tube; thus sweeping out all traces of air. After this has gone on for about three minutes, the tube connecting the three-way tap with the absorption-bottle is closed by a pinch-cock; and the gas receiver, having been completely filled with mercury, is joined to the other end of the combustion-tube—care being taken to avoid entrance of air. The pinch-cock intervening between the carbon dioxide generator and the three-way tap is also closed. The india-rubber tube connecting the absorption-bottle with the three-way cock is then temporarily removed; and after displacing all air in the burette with mercury, coal gas is admitted by connecting with the gas supply and lowering the aspirator bottle—the gas being adjusted to the 100 c.c. mark by levelling the height of the mercury. The absorption-bottle is now again attached to the three-way tap, and the pinch-cocks both here and at the top of the receiver opened. The gas is then slowly chased over from the burette through the absorption-bottle and the combustion-tube; the rate at which the gas is passing being ascertained by observing the bubbles in the absorber. The displacement of the 100 c.c. of coal gas should occupy about 15 minutes. When this is done, the connection with the burette is closed, and the tap is once more connected with the carbon dioxide generator, from which a current of carbon dioxide gas is slowly passed through the whole apparatus—displacing the coal gas in the absorber, and carrying over into the receiver all the nitrogen in the combustion-tube. The mercury in the receiver is brought during the experiment nearly to a level, maintaining the gas, however, under a slight pressure, and adjusting the same by means of the small tap at the bottom, so that, when the gas reaches the 150 c.c. mark, and the pinch-cock at the top and the tap at the bottom are simultaneously closed, the levels of the two columns of mercury are coincident with each other. The receiver is then disconnected; and the combustion-tube having been opened to the air, the pump is again started to reoxidize the copper oxide. The wide-mouthed limb of the receiver is then filled with mercury, and 100 c.c. of the gas passed into the Hempel burette; the carbon dioxide being absorbed with caustic soda in the usual way. It has also been found necessary to remove traces of oxygen from the gas before taking the final reading as nitrogen. The average amount of oxygen in coal gas, as taken from 19 experiments upon the gas of towns in all parts of the United Kingdom, is, according to Frankland, about 0·3 per cent.; and a varying amount of this oxygen passes over the nitrogen and carbon dioxide, though it would be supposed that a considerable portion would be retained in order to reoxidize the reduced copper. Having therefore, removed all oxygen, the volume of remaining gas is noted, calculated on to 150 c.c., and after correction for temperature and pressure gives the percentage per volume direct. In summarizing the foregoing, there are five precautions which it is advisable to observe: (1) To work the apparatus under a slight pressure; (2) to make sure that all air is displaced before commencing the experiment; (3) to ascertain that the carbon dioxide used is wholly absorbed by caustic soda; (4) to thoroughly reoxidize the copper oxide, so as to avoid the presence of any metallic copper in the tube; (5) and, lastly, to pass the coal gas at a rate that will ensure complete oxidation.

The figures given below indicate the amount of nitrogen found in the Salford gas as supplied to the Manchester Technical Laboratory; being a series of tests made at different times during a period of several weeks:—

No. of Experiment.		Nitrogen per Cent. per Volume.		No. of Experiment.		Nitrogen per Cent. per Volume.	
1	..	14·1		9	..	10·3	
2	..	13·5		10	..	6·3	
3	..	13·8		11	..	7·0	
4	..	8·7	Day.	12	..	7·3	Night.
5	..	7·4		13	..	7·6	
6	..	6·4		14	..	7·8	
7	..	10·9		15	..	4·6	
8	..	11·7					

The author then went on to remark that, in the early days o the gas industry, it was considered highly detrimental to the quality of gas to admit the slightest quantity of air; and he quoted, in support of his statement, an extract from a report made in 1878 by the then Manager of the Salford Gas-Works. He also gave a table showing that gas of 25-candle power is reduced to 22·25 candles when 2 per cent. of air is added, and to 16·75 candles when 5 per cent. is introduced. It was therefore, he said, safe to assume that the quantity of nitrogen found in Manchester gas, as given in Roscoe's translation of Bunsen's "Gasometry," might be taken as representing the amount of nitrogen existing in the gas itself, and not due to the introduction of air—the amount there stated to be present being 2·46 per cent. He then gave the two following analyses of the gas of Manchester attributed to Bunsen; recommending the second as being the more suitable for the purposes of comparison:—

	No. 1.		No. 2.
Hydrogen	45·58	..	45·58
Marsh gas	34·90	..	34·90
Illuminants { Elayl	6·46	..	4·08
Illuminants { Dietryl		..	2·38
Carbonic oxide	6·64	..	6·64
Sulphuretted hydrogen	—	..	0·29
Nitrogen	3·67	..	2·46
Carbonic acid	—	..	3·67
Oxygen	2·46	..	Nil.

Mr. New next pointed out that the amount of nitrogen occurring in coal gas was in many cases much greater in 1883 and 1884, when the use of air was on the increase, than it had previously been. This he showed by the following figures, giving the percentage of nitrogen, as ascertained by Frankland, in the gas supplied about that time to the towns named: London (The Gaslight and Coke Company), 5·95; Liverpool, 6·10; Birmingham, 10·10; Bristol, 5·11; Newcastle-under-Lyme, 6·22; Ipswich, 10·84; Preston, 4·79. He also showed, by the results of tests made at different times on several days, that the amount of nitrogen is much larger in the daytime than at night—an occurrence which, he remarked, was of such significance as to need no explanation. In one case, the percentage of nitrogen was 11·7 at 1 p.m., 10·9 at 1.30, and 8·7 at 4.30; in another, it was 13·8 at 4.20; in a third, 14·1 at 1; in a fourth, 10·3 at 7.30. Other tests showed 4·6 per cent. at 8; 7·6 per cent. at 8.20 (and 7·8 per cent. at 9.40); 7 per cent. at 8.50 (and 7·3 per cent. at 9.20).

In the discussion upon the paper, the Chairman (Mr. Levinstein) asked whether he fully understood the author to say that there was more air in the gas in the daytime than in the evening. If so, how did the air get into the pipes? If it were pumped in, how did he know there was more in the house than at the station? He understood it was due to the distance. Mr. Stenhouse thought the results obtained by Mr. New were most extraordinary, inasmuch as the 14 per cent. of nitrogen at 1 p.m. (given among his tests) meant a great quantity of air, which must have been purposely forced into the gas; and not only would there have to be a large quantity of air pumped in, but there would have to be a corresponding proportion of oxygen. Probably the oxygen would be reduced 1 per cent., assuming the coal gas to contain 1000 grains per 100 cubic feet of sulphuretted hydrogen. There would be sufficient oxygen to oxidize the sulphuretted hydrogen and deposit all the sulphur. Therefore a quantity of air would go forward. Was it quite certain that all the compounds that should be absorbed by the sulphuric acid were taken up by simple bubbling? Surely the gas had to be agitated with the different reagents before the compounds were absorbed. Dr. Grossman asked if the author had made an analysis of the air; and, if so, what figures he had obtained for nitrogen. The apparatus seemed to him to require to be handled very carefully, or the results would not be reliable to the extent of 1 or 2 per cent. Mr. Stenhouse stated that, according to a recently published analysis of London gas, the average was 0·15 per cent. by volume of oxygen, and less than 1 per cent. of nitrogen; and this was greatly different from the results shown by the author. In reply to the last speaker, Mr. New remarked that Frankland found on more than one occasion 10 per cent. of nitrogen; and he had himself found oxygen in coal gas to an extent which would correspond to the excess left after that which was required for reducing the sulphuretted hydrogen had been used up. In regard to the complete removal of the compounds absorbed by sulphuric acid, this was only used in a bubbling-bottle, in order to ascertain the rate at which the gas was passing. As a result, some of the hydrocarbons were absorbed; but it was immaterial whether they were or not, since they would all be decomposed during their passage over the red-hot copper oxide.

WESTERN (U.S.A.) GAS ASSOCIATION.

Annual Meeting at Detroit (Mich.).

The Fifteenth Annual Meeting of the above Association was held at Detroit (Mich.), under the chairmanship of the President—Mr. E. G. Cowdery, of Milwaukee—on the 18th of May, and two following days.

After an appropriate greeting from the Hon. H. S. Pingree, the Mayor of Detroit, the President proceeded to deliver his Inaugural Address. In speaking of the objects of the Association, he mentioned that it now included 280 members; and he claimed that Gas Managers' Associations had done much towards enabling gas to be sold at existing low rates—many companies having already reached the dollar limit. He also suggested that, in addition to the ordinary meeting with social features, as at present held, the objects of the Association would be advanced by a private gathering of the members, held with closed doors, at which matters interesting to themselves only could be discussed. He would prefer that, in deciding the place of meeting, the gas company in the town proposed should not be first consulted, as, in encouraging the Association to come, the company felt bound to some extent to follow precedent in the matter of hospitality. If the Association first

decided the place of meeting, the local company would be left free to follow its own inclinations in that respect. And he did not approve of a fixed date for the meeting, but would like the Committee to be at liberty to alter it, in the event of any local matter rendering it advisable to do so. Speaking of the municipal control of gas undertakings, he thought that this was advocated chiefly by those whose knowledge of the gas business was limited, and that amongst those who were acquainted with forms of government, and with the gas industry, the prevalent opinion was that a municipality could not successfully control gas supply or any other public service that was not universally used, and was not an absolute necessity. Those who were qualified to judge knew that the public was infinitely better served by private corporations, than by municipalities, who had no pressure of competition to drive them to seek cheaper methods and ways of improvement. As to the comparisons made between European cities and those of America, it must be remembered that in Europe the forms of Government were different, and were generally better adapted to the success of any service under municipal control. But while he believed that the gas supply should be left to the companies, he agreed that there should be legislative control. Though the result of the introduction of electricity had been to displace gas for some purposes, and to check temporarily the growth of its consumption, it had educated the public to require more light; and, as a rule, it was not able to compete with gas at less than 8s. 4d. per 1000 cubic feet. It was generally understood that incandescent electric lighting plants were not making a profit, and, further, that there was no prospect of a material reduction in the cost of producing electricity so long as the steam-engine and boiler were necessary to this end. No great strides had been made during the year in the distribution of fuel gas for general purposes; but he believed in its ultimate success. At the present time, it could not be made and distributed at a sufficiently low price to allow it to come into anything like regular use for domestic operations. But if something approaching this could be attained, no doubt there was room for a good business to be done in that direction only. The President proceeded to give details of an attempt he had made to meet the demand for fuel gas, by supplying ordinary gas during the daytime at a discount of 20 per cent. Since Jan. 1, 1891, the price for illuminating gas had been 4s. 2d., and for fuel gas 3s. 4d. per 1000 cubic feet; and the result was that the increase in the number of consumers and the quantity of gas consumed, was far greater during 1891 than in any previous year. The fuel gas was employed largely for various technical purposes as well as for household cooking; and rather more was used in the summer than in the winter. There was a tendency at the present day to give up the old method of making coal gas, in favour of new systems; but he would point out that coal gas possessed many advantageous features as compared with water gas, and that the objections as to the large amount of labour required were rapidly being removed, in large works at any rate, by the introduction of machinery, generator furnaces, inclined retorts, and other improvements. Yet at no time in the history of gas lighting had it been more necessary to consider the introduction of water gas processes, to be used exclusively or in conjunction with coal gas; and this not so much as a matter of cost, but on account of the necessity for increasing the illuminating power beyond the present possibilities of coal gas. Gas of 25-candle power and upwards should now be the aim of all; and water gas appeared to be the cheapest and readiest means to adopt towards that end. In commenting upon various topics suggested by the titles of the papers to be read, the President expressed strong approval of the standard dimensions for cast-iron flanges, &c., as proposed by the Society of Gas Lighting.

The report of the World's Fair Committee appointed at the last meeting was read by Mr. Ramsdell. After detailing the steps first taken in the matter, the Committee expressed their satisfaction with the manner in which the representation of the gas interests at Chicago had been taken in hand by the Gas Industry Council; and a confident opinion that the interests of the fraternity were being served as thoroughly and efficiently as possible. They insisted on the importance of a prompt response to the appeal that had been made to the members for subscriptions. In asking for their discharge, they recommended the Council to the hearty support of the Association.

Captain White thought that the Council might confidently appeal to that meeting for support, seeing that they were not working for their own individual benefit, but for the good of the gas industry at large. If any were benefited more than others, it would be those gas undertakings which were in the neighbourhood of Chicago. There were not two sides to the question. Either they must be properly represented at the Exhibition, or take the position the electric people desired to put them in—that of representing a fading and expiring light.

Mr. A. C. Humphreys, at the request of the President, opened the discussion on this subject by inviting questions, and promising to give every possible information to the best of his ability. The project was a great one; and it was unavoidable that misunderstandings should arise in connection with it. He believed it would be carried through; but, to make a success of it, there was needed a greater degree of support from the gas managers than had hitherto been shown, as the building had to be finished and handed to the authorities in October next. The Council felt confident that they could do this, and that the scheme would not fall through; but they could not do without the hearty support of the Western Association. At present about £11,000 was promised; and they needed £25,000. Of this sum, £15,000 would be needed for the building, and the remainder for its equipment and maintenance during the six months of the Exhibition. He then proceeded to give details of the plans of the building proposed, which would include apartments set aside for the use of subscribers and their friends. They wanted to do all that was done in the Gas Pavilion at the Paris Exhibition, and a great deal more. An International Gas Congress had been suggested, as well as other things.

Mr. M'Donald followed with some explanations as to the causes which had led to the resignation of the American Association Committee, and the subsequent handing over of the matter to the Gas Industry Council. The chief difficulty was, he said, that the members of the Committee were spread abroad all over the country; rendering it a matter of time and expense to bring them together. He dwelt at some length on the necessity for a gas exhibit, and the advantages which would thus accrue to gas companies generally.

Mr. Egner submitted a resolution approving the efforts of the Council, and recommending their scheme as deserving of support. The President said that many had withheld their subscriptions because it was rumoured that the western cities were not contributing, and that the Chicago Gas Company, who would supply the gas, would not support the movement. Mr. Stiles, an ex-President of the Electric Light Association of Chicago, said there was a general impression that the gas interests did not care to be represented at the World's Fair; and this was one reason why no special provision had been made for them. The electric lighting people had been continually before the authorities; but no one came on behalf of gas. He entirely agreed with previous speakers as to the importance of an adequate representation of gas at the Exhibition. Several speakers expressed themselves favourable to the movement, and promised subscriptions; some adding a personal donation in addition to that given by their company. Mr. M'Donald said the Chicago Gas Company would support the Council; and he added that none of the money contributed would go to pay the expenses of exhibitors of appliances.

Mr. Humphreys, in replying, said the World's Fair Commissioners certainly did not do so much at first as might have been expected; but when they found that a determined effort was to be made to secure a representation for gas, they were willing to meet the Council as far as possible. Now that the Council had fought for the rights of gas, and had obtained a recognition, it would be more injurious than ever if those connected with the industry failed to support them. If the matter fell through, subscriptions paid would be returned—perhaps with a small *pro rata* deduction for expenses.

Mr. Egner's resolution was unanimously adopted.

Mr. C. M. Higgins, of New York, then read a paper on "Petroleum Products employed in Gas Manufacture." It dealt with the advantages of naphtha, as compared with crude oil, for the purpose mentioned. The first running from the still, in refining crude petroleum, is known as crude naphtha; and this, when refined by a second distillation, becomes the naphtha of commerce. Gas naphtha is usually between 57° and 63° Baumé as regards specific gravity, free from light and heavy grades, and also from sulphur. Properly treated it is entirely convertible into gas; any residue of soot or of tar being the result of working at improper heats. Absence of naphthalene is a feature where naphtha is properly used. One gallon yields 132 cubic feet of 20-candle gas, or 83 cubic feet of 70-candle gas. If used in conjunction with coal, a ton of this material and 11 gallons of naphtha produce 12,425 cubic feet of 20-candle gas. When used for enriching water gas, the average consumption of material is 35 lbs. of Connellsville coke and 4¼ gallons of naphtha per 1000 cubic feet of 21¼-candle gas. A 23-candle gas has been produced from 36 lbs. of coke and 4¼ gallons of naphtha per 1000 cubic feet. Some results showed 12 or 15 per cent. less naphtha, and more coke or coal. He lately had to review the accounts of a works where efficient apparatus was employed under skilled management, and he found that 45 lbs. of coke, and upwards of 7 gallons of crude oil were used per 1000 cubic feet of gas manufactured. Comparisons made in four different works showed that the additional quantity of crude oil required more than balanced the lower price as compared with naphtha, to say nothing of the additional cost involved in collecting the tar. A material of uniform composition, giving an even candle power of permanent gas, short runs, and regular heat, was the thing required; and therefore naphtha was cheaper and more easily worked than crude oil.

Discussion having been invited, Mr. Egner said that, while cheerfully endorsing most of the particulars given in the paper, he could not allow the whole of it to pass unchallenged. After 20 years' experience with all kinds of products, he would venture to correct the somewhat one-sided argument in favour of naphtha as compared with crude petroleum, and at least one of the products—the intermediate distillate. He had used Lima crude oil for years, and found no difficulty in getting a better yield of gas than could be obtained from any of its products. The tar could be collected free from water, and sold at as good a price as coal tar. The results quoted in the paper for crude oil were certainly far below the usual average. Apparatus of

the Lowe and Springer type was certainly less suited for crude oil than for naphtha; and he would agree that naphtha was the best, even at a somewhat higher price, where this sort was employed. The fixing chambers were not large enough to get the best results from the oil. He considered that the Flannery apparatus was the best for crude petroleum. For enriching coal gas, there was no better or more suitable material than naphtha. In 1887 and 1888 he published the results of several years' operations with it—showing an absence of naphthalene, and that a coal yielding 9780 cubic feet of 17-candle gas per ton gave 10,960 cubic feet of 19½-candle gas in conjunction with 4·8 gallons of naphtha. At St. Louis he repeatedly tried crude oil, and naphthalene appeared each time; but, on reverting to naphtha, it always disappeared. Mr. Humphreys said the best result quoted for naphtha, after allowing the 15 per cent., was 5·9 candles per gallon. At many works in which crude oil was used, and which were not specially designed for that substance, this result was equalled; and with specially arranged apparatus it was exceeded. Reference had been made to the tar; but this was always worth more than the oil from which it was produced. He would not advise anyone to pay more for naphtha than for crude oil, as he knew many gas engineers who preferred the latter at equal prices. Of course, the apparatus employed must be properly designed for handling the crude oil; and where this was provided, they could be independent of the oil merchants, as they could use crude or any product that happened to be cheap. They must not conclude that the absence of liquid residuals proved that the whole of the naphtha was converted into gas. Some might be deposited as carbon on the superheated bricks, and be burnt at each heating up. Mr. Somerville agreed that naphtha was the best at anything like equal prices. He had found the crude oil a failure in every way—in economy, in candle power, in its odour creating a nuisance, and in the pipes becoming choked with pitch. Mr. Lansden said the prices of crude oil were always variable, but there was a regular supply of naphtha; so he preferred to use the latter. He did not, however, find that it got rid of naphthalene. Mr. Young believed in having apparatus suited for any grade of oil or naphtha. He was now using naphtha; but he was occasionally troubled with naphthalene, which was not the case when he used crude oil. The odour and the fluctuations in price were the objections to the latter. He had experienced difficulty with regard to the supply of crude oil, but not with naphtha. Mr. W. L. Brown had used naphtha, with a Pratt and Ryan plant, for the last two years. He averaged 5 gallons of naphtha, and from 42 to 45 lbs. of coke, per 1000 cubic feet of gas made. He had no lampblack, and practically no tar. Mr. A. S. Miller, said he made a 28-candle gas from 4·6 gallons of crude oil and 33 lbs. of soft coke; and the cost of purification was less than ¼d. per 1000 cubic feet. The production of naphthalene was due to having the superheater too hot; and it could be readily avoided whatever the material employed. The President said he used naphtha, and found that naphthalene was produced if the part of the apparatus where the liquid was converted into gas was too hot. Mr. G. T. Thompson said that naphtha was preferable to crude oil for retorts; it did not deposit so much carbon.

Mr. Higgins, in reply, said he knew the Company represented by Mr. Humphreys worked very carefully; but he questioned whether those outside averaged better results than he had quoted in his paper. The refiners could not avoid the production of naphtha in their business; and therefore the supply of it was more regular than that of crude oil. He was not a gas engineer, and therefore could not deal with some of the questions raised.

(To be continued.)

Exhibitions of Gas Appliances.—Last week the Davis Gas-Stove Company, Limited, held exhibitions of their appliances in the Public Hall, Wigan, and in the St. Saviour's Schools, Bristol. At the former place, Miss Ida Cameron gave a series of lectures on cooking by gas; a similar course being delivered by Miss Rotheram at the latter.

Additional Storeage at the East Retford Gas-Works.—Messrs. R. and J. Dempster have just completed a new telescopic gasholder for the East Retford Corporation Gas-Works. It forms part of the extensions now being carried out by Mr. J. B. Fenwick, the Engineer of the gas and water undertakings of the Corporation; and it is a good example of the excellence of the firm's work.

The Purchase of the St. Petersburg Water-Works by the Municipality.—Mention has already been made in the JOURNAL of the intended purchase, by the Municipality of St. Petersburg, of the undertaking of the City of St. Petersburg New Water-Works Company, Limited. The step is being taken in accordance with the terms of the original concession. Before the actual sum due to the Company can be fixed, it is necessary to ascertain precisely what was the net revenue for the last working year; and what extra works are to be paid for, and their value. The Municipality have referred the matter to a Committee, with power to negotiate with the Company with the view to a settlement of these points, and generally as to the purchase, so as to avoid the necessity of calling in an arbitrator; and they have invited the Company on their part to name representatives to negotiate for them. The Directors desire to have the authority of the shareholders to settle these matters, and any others which may arise in the course of the negotiations, by amicable arrangement with the Committee; and they will ask the shareholders to grant them this authority at a special meeting to be held next Thursday.

REGISTER OF PATENTS.

Gas-Engines.—Withers, S., of West Kensington, and Covert, D'E. S., of Hammersmith. No. 9931; June 11, 1891.

The object of this invention is to employ the reverse motion of a vibrating piston to compress the charge of gas and air, and to force it into the chamber on the reverse side of the piston or blade where it is exploded.

The cylinder is circular in form, and is divided into two sectional chambers (right and left) by partitions or bulkheads placed vertically; these chambers having an arc of about 90°. In the chambers vibrate the piston blades, which radiate from a central trunnion oscillating in bearings carried in the covers or sides, which are bolted to the shell or cylinder. The trunnions are extended beyond the covers; and the vibratory motion is communicated to a crank, and converted into rotating motion, by any suitable means. The chambers are again divided into two spaces by the piston blades; the spaces under the blades forming the explosion chamber, and those above the compression chambers. The action of the engine is as follows: When either of the blades is forced up by the explosion, the opposite blade (descending) draws in after it, through suitable ports and valves, a charge of gas and air; at the same time expelling, under or in front of it, the product of the previous explosion. On the return motion, the charge of gas and air just drawn in is compressed, and forced into the space under the descending blade, where it is ignited at the proper moment; and the explosion forces the piston up or back—thus producing the vibrating motion on the piston blades. The supply of gas and air, the transference of the charge from the compressing chamber to the firing chamber, and exhausting products of combustion, are all effected by means of suitable valves. The relative capacities of the compression chambers to the firing chambers can be varied by a sectional enlargement of the trunnion on the compression side of the blades; and the upper bulkhead, being reduced to correspond, effects an expansion of the explosive charge beyond its original volume.

Gas-Stoves.—Holder, W., of Newport, Mon. No. 10,356; June 18, 1891.

This invention relates to gas-heating stoves, constructed of two vertical tubes or cylinders, the innermost of which is fire-clay while the outer tube is made of any suitable material. The inner cylinder is made in sections, and is furnished at suitable intervals with diagonal perforations for the asbestos fibres. These sections have suitable devices at both ends by which they are bound together; thus forming a cylindrical pillar of flossy asbestos. The outer cylinder is an inch or so larger in diameter than the inner tube; and the base of the stove is so constructed as to receive the cylinder and hold it firm vertically, while it is so formed as to hold the water necessary for the withdrawal of the bye-products of combustion which accumulate therein as the products impinge on the surface of the water. In the centre of the base is an atmospheric or other burner, which communicates directly with the centre of the asbestos-lined inner tube at the bottom. The gas when alight is retarded in its ascent by the asbestos fibre; thus causing the latter to become incandescent. Consequently, the fire-clay tube is heated on both sides at the same time—first by direct contact with the inside, and by escaping at the top and descending the outer tube (in the centre of which the former is fixed), and purified heated air escapes by small perforations at the bottom of the outer tube.

Gas-Engine Starter.—Lanchester, F. W., of Bedford Row, W.C. No. 11,861; July 13, 1891.

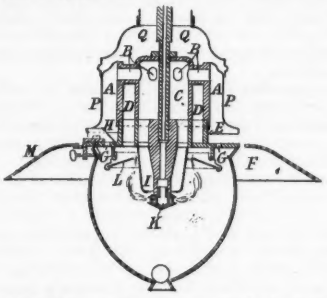
In applying this invention to a single cylinder, single-acting engine of the "Otto" cycle, the piston is set well back on the exhausting stroke, so as to keep the exhaust-valve open to the exhaust-pipe; and there is admitted to the exhaust-pipe, (which is filled with air drawn into the engine cylinder when stopping, after cutting off the gas), a charge of gas from the gas supply-pipe which gas flows in under the ordinary pressure of the gas-mains. The piston is then moved out by reversing the common direction of the rotation of the engine fly-wheel, and so there is drawn into the cylinder a charge of air and gas from the exhaust-pipe by way of the exhaust-valve. The rotation of the fly-wheel is continued; and at the out-end of the piston stroke the exhaust-valve closes, and the piston is moved back, so as to compress the charge thus taken into the cylinder. Immediately the pressure rises to a sufficient extent, the mixture ignites at the ignition-tube; and the engine receives a powerful impulse, which at once starts it rotating in its normal manner.

The gas may be adjusted to flow into the exhaust-pipe in the volume required by regulating the time during which the gas-valve remains open, or by measuring in the charge of gas—using a pump or bellows or gas-bag arrangement; but the patentee prefers the following devices: Upon the exhaust-pipe leading from the exhaust-valve of the engine is arranged a chamber, into which the exhaust-pipe projects, leaving a considerable cubic capacity above the lower end of the pipe; while another pipe leads from this chamber to the open air. The gas is admitted to the upper part of the exhaust-pipe, and flows in so as to displace the air in the pipe; and any excess gas passes up around the projecting part of the pipe in the chamber, so that, when the engine is rotated backwards (to draw in a charge by the exhaust-valve), the excess of gas does not enter the cylinder, as air comes from the exhaust-pipe communicating between the chamber and the atmosphere, and passes by the projecting pipe, which it opposes, without taking any excess gas from the chamber.

In the case of twin cylinders with the pistons working together on the same crank-pin, the crank is set well on the in-stroke under the centre; and in this condition, one of the pistons is on its compression stroke and the other on its exhaust stroke. The cylinder on its exhaust stroke is charged with gas as already described; and that on the compression stroke, is charged and ignited as described in patent No. 19,868 of 1889. The engine pistons then move out, rotating the fly-wheel in the direction opposite to the normal, propelled by the low-pressure explosion. This causes the second piston to compress its charge when returning; and so soon as it is sufficiently compressed, the igniter tube fires the compressed mixture, and at once propels the piston and starts the engine in the proper direction.

Regenerative Gas-Lamps.—Breymann, W., of Berlin. No. 7514; April 20, 1892.

This invention has for its object "to promote within as large a circular area as possible the combustion of gas by means of hot air; the burner being of the smallest possible size and capable of being produced at the lowest possible cost."



The lamp consists of a cast-iron frame or body A furnished with a set of radial tubes B, also of a circular cast-iron base E connectable thereto, and provided with a flange F having a circular row of air-holes G. It is furnished at its lower end with an ignition piece or nipple K, the circular periphery of which is provided with small perforations. The cone I (porcelain) is fixed to the base by a bayonet joint; while L M are the inner and outer reflectors—the glass globe being fixed by screws. The cylinder P is secured to the projection H; and, by resting on the body, it shuts off the air from the products of combustion. The cylinder P supports the canopy Q, and a chimney and smoke cap or cover. The gas inlet-pipe is fixed in the base of the lamp, and passes through the body, to which it is secured by a nut.

In action, the gas issues horizontally and circularly within the lamp globe; is ignited at K; and the flame is drawn through the annular opening of the inner shade L and around (but away from) the porcelain cone I towards the hollow space D, so as to assume a bell or tulip shape. The hot products of combustion in their upward travel impinge against the radial tubes B and pass through the chimney. The air required for combustion is drawn in through the opening provided for the purpose, and is divided into two parts. One is conveyed upwards through the heated tubes B into the chamber C, and thence to the flame, which assumes a tulip shape through the depth of the porcelain cone I and contracted opening of the shade L; the other part is drawn in a cold state through the holes G into the globe, cooling its walls, and reaches in a heated condition the outer part of the flame. The globe is furnished below with a circular opening, closed by a small ball placed loosely over it, so as to readily allow of lighting the lamp without having to open the glass. The burner, it is claimed, produces, with a supply of 141 litres of gas, a light of 51·3-candle power.

APPLICATIONS FOR LETTERS PATENT.

11,019.—Inglis, G., "Shield or protector for use during the charging and drawing of gas-retort and other furnaces." June 11.
11,037.—Molison, A. R., "Gas-engines." June 11.
11,102.—Anderson, R. B., "Furnaces for heating gas-retorts." June 13.
11,137.—Bullough, C. T., "Measuring liquids or gases." June 14.
11,211.—Gilson, R. A., and Booer, W. J., "Heating bakers' ovens with gas." June 15.
11,243.—Keenan, W., "Automatically moving coal and other material." June 15.
11,273.—Whittingham, F., "The Whitham atmospheric gas-burner." June 15.
11,283.—M'Laren, W., and Collins, B. A., "Railway roof lamps for coal or oil gas, and apparatus connected therewith." June 16.
11,415.—Harvey, E., "Oil and gas stoves." June 18.
11,421.—Smith, H. P., "Gas-pressure indicating apparatus." June 18.
11,469.—Glover, S., Glover, T., and Critchley, J., "A coin-operated device for attaching to an ordinary wet or dry gas-meter." June 20.
11,504.—Chapman, L., "Obtaining oxygen and nitrogen from atmospheric air." June 20.
11,611.—Nunn, A. C., "Heating attachments for gas-burners, and vessels to be used in combination therewith, for heating and other purposes." June 21.
11,729.—Scott, J., and Darwin, H., "Gas-fire body." June 23.
11,800.—Scott, J., and Darwin, H., "An incombustible composition for gas-fire bodies and other articles." June 23.
11,809.—Marcus, S., and Bothe, E. F., "Air and gas carburetting apparatus." June 23.
11,892.—Burne, E. L., "Gas-engines." June 25.
11,928.—Webb, W. Le P., "Gas engines." June 27.
11,949.—Boult, A. J., "Automatic cut-offs for gas-burners." A communication from Eli Denne. June 27.
11,974.—Jones, J. L., "Coin-freed automatic check mechanism for attachment to gas-meters." June 28.
12,066.—Scott, J., and Darwin, H., "Bunsen gas-burner." June 29.
12,067.—Scott, J., and Darwin, H., "Gas-fire bodies." June 29.
12,071.—Pick, W. H., "Water-mains and service-pipes." June 29.
12,165.—Anderson, F. H., "Gas and oil motor engines." June 30.
12,183.—Boult, A. J., "Gas or similar engines." A communication from J. A. Charter. June 30.
12,229.—Thwaite, B. H., "Gas generators of the inclined grate and natural draught type." July 1.
12,323.—Clerk, D., "Gas and like engines." July 2.

The Incorporated Society of Medical Officers of Health has been registered with a nominal membership of 1000; the individual liability, in the event of winding up, being fixed at £1. The management is vested in a Council and 20 Fellows.

MISCELLANEOUS NEWS.

THE METROPOLITAN WATER SUPPLY COMMISSION.

Tuesday, June 28.

(*Lord* Balfour of Burleigh, *Chairman*; *Sir* G. B. Bruce, *Sir* A. Geikie, F.R.S., *Professor* Dewar, F.R.S., *Mr.* G. H. Hill, M.Inst.C.E., *Mr.* J. Mansergh, M.Inst.C.E., *and Dr.* W. Ogle, *Commissioners*.)

On the resumption of the proceedings this morning,

Dr. *Shirley Foster Murphy*, Medical Officer of Health for the County of London, was called and examined. In answer to Sir A. Geikie, he stated that, in obedience to the instructions of the Water Committee of the London County Council, he had arranged with Drs. Ashby Fosbroke and Turner for an investigation of the pollution of the Thames and Lea and their tributaries, with a view to enabling an estimate to be formed of the risks of pollution to these rivers as public water supplies. While there was no doubt that great progress had been made in treating sewage, either by farms or by chemical methods, it deserved to be considered whether, in times of storm, such methods could always be relied upon, and consequently whether the increasing adoption of sewers for towns might not be giving at such times greater facilities than before for their contents to reach the rivers. The security afforded by existing arrangements could at present only be tested by the behaviour of enteric fever; and hitherto there had been no opportunity for estimating the value of those arrangements by the behaviour of cholera. He wished to state that the London death-rate from enteric fever bore favourable comparison with that in other towns having public water supplies which were not polluted by excrement.

In answer to Dr. Ogle, witness said he had made a comparison, in regard to typhoid fever, between London and 14 large towns in which the drinking water was not excrementally polluted; and the result was that in 10 out of the 14 places the enteric or typhoid fever death-rate was higher—in some cases very considerably higher—than in London. In the other towns, the death-rate from typhoid fever was lower than in London itself. The inference he drew from that was favourable, so far as it went, to the wholesomeness of the London Water Supply as compared with that of other towns. When the London districts, supplied by water from the Kennet, Lea, and Thames respectively, were compared with each other in regard to their liability to typhoid fever, considerable differences were observable between them. But these differences in fever incidence could not be ascribed to differences in the water supplied, because similar variations were observable between the groups of districts in regard to their respective liability to those other zymotic diseases which were not communicable by drinking water. No conclusion unfavourable to London water was to be drawn in regard to fever outbreaks.

In reply to Mr. Mansergh, witness said that, in the course of his experience, he had never traced an undue prevalence of typhoid fever to the use of the London Companies' water; and he did not differentiate between the wholesomeness of the various waters supplied to the Metropolis.

Mr. *W. J. Dibdin*, F.I.C., F.C.S., Chemist to the London County Council, was the next witness called. In answer to Sir A. Geikie, he said he was prepared to give the results of investigations carried on by him in reference to the water supply of London. He had received a series of instructions on the matter; the first being to examine samples of sewages to be sent to him by the Medical Officers of Health. These investigations were beyond his ordinary duties as Chemist to the Council.

In reply to Professor Dewar, witness said he would summarize the analyses, and the deductions he had made from them. Dealing with the storm and fine weather periods of the years 1891 and 1892 in part, he said that there were to be found slight differences in the results of the analyses, arising from the various samples being taken from such a vast bulk of water. One fact found was that, when the river was in flood, the water collected at the Companies' intakes was more highly polluted than usual; and the influence of that pollution was distinctly apparent in the water distributed in London. There could be no question that the water supplied in the storm periods was affected to a very considerable extent; so that he would infer that the pollution, whatever it might be, did really pass the Companies' filter-beds, and find its way, in a more or less diluted condition, into their supplies. But the question of whether or not this amount of pollution was injurious, and liable to cause any particular disease, was, he thought, one with which he was not competent to deal. But, to his mind, the question was not altogether and solely one of disease. There was not the slightest doubt that, under certain circumstances, apparently pure water might generate disease; but, in dealing with the question of water supply, one object ought to be to obtain as good water in every respect as it was possible to get under any given conditions. Water, though not dirty, might still be objectionable on other grounds. By means of tables which he would hand in, the Commissioners would see that the quality of the water in October, November, or December was very much worse than in April or May. Summarizing the results of the tables he had prepared, he would say that during the storm period there was a large increase of the total organic impurity; and, whatever was its origin, he objected to it on sentimental grounds, irrespective of whether or not it was dangerous. Regard should be paid to the fact that everyone desired that he should have clean water to drink, as there was no doubt that, in the popular mind, prejudice would go a long way. As to the question of micro-organisms, knowledge on the matter was in such an uncertain and indefinite state that it was impossible to say conclusively that water was injurious because of the number of microbes in it. There was no more delicate test than the microbic one.

Professor Dewar: I put to Dr. Frankland the question whether, if he had had the knowledge which he now has on the subject, he would have written about it what he did in the report of the Rivers Pollution Commission; and I ask you if, with your present knowledge, you would support his view expressed in that report?

Witness: I think some of his expressions are rather strong.

At that time Dr. Frankland had no knowledge that sand filtration could remove 99 per cent. of the most minute organisms?—As a matter of fact, we did not know of their presence.

I could hardly go so far as that, because was not the fear expressed in the Rivers Pollution report as to the presence of these organisms?—But we had no idea of their numbers; and the process of generation among them was not known. Though it was thought there were some present, it was a general notion only; we had no definite knowledge on the subject.

I may put it in this way, perhaps: Modern research as to the separation of these most dangerous constituents of potable water has revealed, in a marvellous way, the 'efficiency of sand filtration when properly conducted?—Unquestionably.

You heard, did you not, Dr. Frankland volunteer to me the information that the filtration of the London water was, as far as he knew, positively perfect?—He did.

I asked him whether he could suggest any improvement; and he volunteered the information that the efficiency of the filtration was much more astonishing than it was shown to be, by the removal of 98 per cent. of matter referred to in the report—that is, when the water was taken from the filters?—I have not had the same opportunity of examining the subject as Dr. Frankland; but, on his authority, I accept the statement unreservedly.

Then there is nothing to support the view that, during the period you complain of as the flood period, the water supplied to London is more deleteriously contaminated with micro-organisms than usual?—It would be impossible to state that on the basis of a computation of the number of organisms being greater or less, because you might have one organism more deleterious than ten thousand others; and as I have no means of determining the degree of deleteriousness of different micro-organisms, I cannot answer your question.

I meant to convey that there was no proof that sand filtration was less efficient as regards the separation of the micro-organisms during periods of flood?—No; I cannot say that there is.

Professor DEWAR submitted to witness an extract from Dr. Frankland's report of 1891 to the Registrar-General, in which he had stated that the operations of those Companies which supply London with water had been most seriously interfered with by dense smoke-bearing fogs in the early part of the year, and by heavy floods in the Thames and Lea during summer and autumn, in consequence of which unfavourable conditions the river-derived waters had often been in a very undesirable state, and well-founded complaints had emanated from people supplied with them. The extract in question went on to state further that the storeage and subsidence plant of these Companies was quite inadequate to deal with the exceptional pollution; and water of bad quality, as regards organic matter in solution, had really been delivered during the last 26 years. Even the Chelsea and East London Companies, whose storeage capacity was from twice to five times that of the others, could not at all times exclude foul flood water. There appeared to be no abnormal amount of sewage contamination; the great additional quantity of organic matter being derived from vegetable sources. Nevertheless the turbidity of the water at the times of maximum pollution was high by reason of the excessive quality of organic impurity and of clayey matter in suspension. In reply to the question whether he agreed with that statement as summarizing the condition of the water during the exceptional flood period to which Dr. Frankland had referred, witness replied that undoubtedly it seemed to point to the fact that there was nothing to complain of from a health point of view; that the large addition of organic matter was to be ascribed to vegetable origin; and that this would account for the variations in the colour of the water. There was no doubt that the amount of pollution was very marked, and was caused by rain washing into the streams. The influence of the rainfall in the upper reaches of the river was more serious than anywhere else—for instance, at Lechlade it decreased, but at Reading it was very high.

Professor DEWAR: You raise no objection to the water supplied to London in the dry weather flow?

Witness: No; it is impossible to raise an objection.

Do you think the Thames has deteriorated within the last 20 years?—Looking to the fact that in storm periods the river is thoroughly washed, I do not see how there can be great accumulations of dirt in it. The only way in which it could be more highly polluted would be by an augmentation of the population. If this increased, one would expect that the character of the river would become worse, because there would be more pollution—that is, providing efficient means of keeping out polluting matter were not had recourse to as occasion required.

Further questioned by Professor DEWAR, witness said that he had read the evidence submitted to the Commission, as to what had been done in the valley of the Thames, and also in the case of the Lea, in regard to purification; but he would say (and further evidence would, he thought, support him) that, although a great deal had unquestionably been accomplished—and every credit should be given for it—there was still such a state of things that there remained a good deal to be done, the completion of which would undoubtedly improve the condition of the river. He had no means of saying whether or not, while there was very much that was bad, from the evidence that had been placed before him, the Thames had deteriorated as raw material for the supply of London within the last 20 years; but he would certainly go so far as to say that there were at present in existence a great many preventible pollutions in the valleys of the Thames and Lea, and that these ought to be checked. Asked whether the pollutions to which he had referred could be checked, he said that undoubtedly there was a quantity of raw sewage constantly going into the rivers; and there was no question that it could be kept out.

Professor DEWAR: Do you agree with Dr. Frankland, who said that, after comparing his analyses of the Thames from Lechlade to Hampton, the latter place was the best from which to take the water for the supply of London?

Witness: I could hardly agree with that; but I must say that my researches have not been so prolonged as those of Dr. Frankland; and I have not examined the river in all its parts.

So far as your work goes, it would rather confirm the earlier report of Dr. Frankland and Dr. Odling in the year 1868, in which they pointed out a remarkable amelioration in the case of the water of the Thames between Staines and Hampton?—I do not always find that to be the case. I find that in bad periods, through the influence of the Colne, there is an increase in the amount of the objectionable matter from Staines to Hampton, but that in dry periods the influence seems to be the other way, and we have an improved condition of things. Putting aside the pollution caused by the Colne, there is no doubt we might, on the whole, do better by going to Staines; but certainly not by going farther afield.

Having put to you what Dr. Frankland stated as to the character of the flood waters during the period to which your analysis refers, I should like, in justice, to allude to another statement with regard to the character of the water in the same period; so that, without going into detail, you could say whether or not you agree with it. It is said that, in consequence of the exceptionally flooded state of the rivers during the greater portion of the month of October, 1891, the character of the water supplied to the Metropolis, in respect to its degree of freedom from organic matter, was, on the whole, less satisfactory than had been found to be the case for a very long time past. Although the New River Company's supply maintained a high average standard, and while the supply of the East London Company from the Lea, and that of the Chelsea Company from the Thames, were, owing doubtless to the large storeage capacity of those Companies, not affected by the flood to any great extent, yet in the case of the other Companies, organic matter was, in different degrees perhaps, present, as indicated by the tint of the water, and was appreciably in excess of the proportions habitually met with?—That seems to fairly represent the fact.

You substantially agree with the analyses which have been published monthly with regard to the character of the water in that period; and your analyses substantially support what was published by the Chemists to the Water Companies, and also animadverted upon by Dr. Frankland in his annual report?—Yes.

Witness then went on to give his views as to the character of the tributaries of the Thames and Lea; stating generally that during storm periods the amount of pollution was great, while in dry weather it was small. The quantity of organic elements in the various tributaries varied with the different months. The Kennet was perhaps the worst tributary, though it had a rival in the Lodden. He would submit that there was a case made out for the investigation of the cause, and for the stoppage of a great deal of the pollution that found its way into the water supply.

Professor DEWAR: Do I understand that you take up a different position in regard to the Lea from that which you assume in regard to the Thames, as to the quality of the Lea water when not in flood? Do you say the Lea is better or worse than the Thames?

Witness: I think the pollutions going into the Lea are so much more direct and so much more gross. Though perhaps smaller in quantity, yet, in proportion to the size of the stream, there is more palpable and direct pollution than in the case of the Thames. Supposing you have the Lea thoroughly washed out by a storm, these pollutions go in again; and though they may be in a diluted form, still they are there.

So that you think the River Lea is really more dangerous than the Thames?—Bacteriological considerations come in there.

I do not mean that. Is it organically more objectionable?—I cannot say that. My guide must be the water at the Companies' intakes; and if we look at that, it hardly bears out the idea that would be conveyed by an examination of these known pollutions. At Ponder's End, Hampton, and other intakes, we have a state of things which is favourable in regard to the Lea. Undoubtedly the Hertford sewage pollutes the stream; but still, generally speaking, there is not much to choose between Hampton and Ponder's End.

Then do you say that, provided you exclude the flood water, the Lea is in such a condition that you raise no objection to it during the dry weather flow?—If these various direct pollutions are kept out.

But, irrespective of your knowledge of the direct pollutions, what would you say with regard to the water as supplied?—I say that the dilution is so great that apparently there is nothing to be said.

Your view is that the pollution goes so directly into the Lea that you cannot imagine it has time to be transformed in the way you think it would be transformed in the course of a long run?—That is so.

You think the element of time is a most important one, and the flow of the Thames being much longer, you fear seriously that, in the case of the Lea, there is merely dilution?—In the case of the Thames, you may have sewage going in a short distance above the intake at Staines; but there is only a few hours' flow for it, and there is scarcely time for purification. In the water which is to be used for the supply of a town, and especially one like London, every possible effort should be made to keep out the whole of the sewage pollution. Under the present conditions, I submit that this is not done.

Mr. MANSERGH: Does not what you have said about the Lea rather point to the fact that, although the pollutions may be very bad in character, their quantity is very small?

Witness: The dilution is very great.

For instance, take Luton. The great bulk of the sewage is treated admirably upon a farm, and only a small quantity descends?—Yes; and the same with regard to Hertford, Bishop's Stortford, and other places. No doubt the pollution in these cases may be very strong; but it is in small quantity, and the dilution is great. There is distinct evidence that, at the commencement of the intake, I found solid sewage—small in quantity, it is true; but nevertheless it was there, and it ought not to have been there.

In reply to Professor DEWAR, witness said he thought that, as the Luton sewage could be treated well, so far as regards day sewage, there was no reason the night sewage should not be effectually dealt with.

Professor DEWAR: May I put it to you that, in your opinion, it would be advisable in all cases to apply the effluent to land, even after chemical precipitation?

Witness: Where you have to turn an effluent into a river which has to be used for drinking purposes, I do not think anybody should allow that effluent to go in without perfect filtration through land—not merely passing it over the surface, but giving it absolute filtration.

At Hertford the sewage is treated by filtration, is it not?—Yes; but the Hertford effluent is rather a peculiar one, and I never met with one

like it before. There is so much infiltration into the town drains, that considerable dilution results; so that the effluent would appear to be wonderfully pure; whereas the apparent purity is, in reality, due to dilution. But there, again, I found solid sewage. We find there is considerable purification, but still the free ammonia and other constituents are high. Regarded as a sewage effluent, it is wonderfully good; but looking at it as water going into a water supply, it is altogether exceedingly objectionable.

So you think that sewage effluent ought to be applied to land in any case?—Undoubtedly.

You say there is not sufficient time allowed to elapse for the purification of the foul matters that are washed into the streams; and therefore these must be present, in a more or less diluted form, in the waters drawn at the Companies' intakes?—That is so.

Witness then dealt with the question of impounding flood water; saying he was of opinion that undoubtedly clarification was obtained by this method, but how far the bacteriological element was to be taken into account he could not state. He had not examined into the effect of impounding water; and had had no access to the reservoirs of the East London Water Company to enable him to make an examination, which should be made. Impounding of the water would be of use if mud were not allowed to accumulate at the bottom of the tank, and if the reservoir were clean. Under these conditions, it would undoubtedly do good, and would benefit the flood waters; and seeing that there was obtained a separation of the objectionable matters by subsidence, there must be an improvement. Moreover, there ought to be, in connection with this, adequate bacteriological treatment, so that the organisms did not multiply at too great a rate. He was of opinion that, as the quality of the water delivered by the Companies in London in wet weather was often very inferior to that supplied in dry seasons, it was undoubtedly because the means of purification were inadequate to deal with the greater quantity of organic matter then present in the water; and the conclusion was inevitable that the polluted water in the storm periods was not a proper source of supply. This was on the ground, as he had already explained, that, although it was organic matter which might be harmless, it was still sentimentally objectionable. In the case of water used for a town's supply, it ought to be perfectly clear; and if it could not be clarified by means of filters, this ought to be done in some other way—either by avoiding taking in the sewage, or by adopting other methods of purification. Something further in the way of purification in storm periods might be effected.

Professor DEWAR: Irrespective of the storm periods, even with all these pollutions going in, to which you have referred, you can raise no definite complaint, as regards the water supplied to London, with reference to chemical sewage, can you?

Witness: As to chemical sewage, that is a question of quantity; and the quantity may be small, but still very objectionable in quality.

As I understand your position, it is that, although the filtration of London water shows, on the whole, large purification as regards the presence of mere organic matter, and goes the length of removing more than 98 per cent. of all living organisms, that to your mind is not sufficiently satisfactory?—I do not think that any degree of purification, whether eliminating 99 or 99·9 per cent. of matter, would be sufficient which left a yellow, turbid water. The supply would not be acceptable; and it would not be advisable to have it. The water might be, organically, absolutely pure; but still a dirty, clay-coloured water ought to be avoided in the case of London. It would be objectionable.

But you could not separate 98 per cent. of the micro-organisms and not have clear water?—It might be highly coloured, though clear; though no doubt this might be due to vegetable matter in solution.

And this could not be removed by any process of filtration?—No doubt that is so; but still it ought to be avoided, if possible.

You have probably tested water in Glasgow, and you are aware that it is a great deal more highly coloured than it is here, and yet it is not objectionable?—But it is a matter of common knowledge that there is no contamination there.

In short, you object to peat here, but not in Scotland?—I object to peat in conjunction with sewage.

Referring next to the construction of storeage reservoirs for potable water in the valley of the Thames, witness said he thought them inadmissible there, as they would be charged with foul water instead of clean water collected from an unpolluted gathering-ground. The valley of the Thames included, more or less, all kinds of water; and, in order to procure water for storeage purposes, it would have to be collected over a great area more or less populated in every part, and there would almost surely be sewage contamination in such water. The only way in which it would be possible to obtain perfectly uncontaminated water would be by preparing the ground for it; and this might perhaps be done. He would not use the word "pollution" as applied to water, if that water were coloured by peat. He would say "organic impurity," but certainly not "pollution," in that case.

Professor DEWAR: Then, to specify your views, you would say that there is only one remedy, and that is to go to a gathering-ground where there is no human habitation?

Witness: "No human habitation" is rather a strong expression to use in that sense; but I should think (speaking for myself merely, and not expressing the views of the County Council) that, if the present sewage contamination in the watersheds of the Thames and Lea were kept under control during one season, we should be safe, while during the other season it would be a question of how far the water supply could be supplemented by underground stores. Beyond this, it becomes a geological or engineering question; and I am not competent to go further into it. As far as I see at present, it does not look as if simply collecting the water coming down the valley of the Thames would provide a suitable supply.

Mr. HILL: If the towns now utilizing their sewage upon land were properly under control, and the work were well done, do you think there would be any objectionable feature in an effluent going into the river?

Witness: The effluent should be passed through land—not over land, but through land—and thoroughly filtered. Then I think there would be very little objection.

Supposing you have a hot summer, raising the temperature in the reservoirs, what would be the effect then?—Supposing you had a clean bottom to the reservoir, and no accumulation of mud, you would still have a quantity of bacteriological organisms, and they would feed on the organic matter there. Nevertheless, purification might be brought about in time, and you might get a good wholesome drinking supply. The whole thing is a question of time.

Questioned by Mr. MANSERGH, witness said it was a matter of surprise to him that there were not systematic examinations of water, just as there were of gas, and penalties inflicted in case of anything being wrong with the quality. When told that sand filtration would remove 99 per cent. of the bacteriological matter, it only conveyed to him the idea that there was still 1 per cent. left in the water; and if it should be shown to him that, after the filtration, there was more matter in the water than 1 per cent., it would only mean that it had found its way in after the filtration, or that the filtration had not been adequate to exclude 99 per cent. of bacteriological matter. Ordinary sand filtration would, no doubt, keep out the exuviæ of small animals, such as shrimps and microscopic eels.

Professor DEWAR: Am I right in interpreting your view with regard to the storeage of water in the Upper Thames Valley when I say you mean that the impounding of water under the conditions which you define—a clear bottom and a certain depth of reservoir—in a suitable locality, aëration would be beneficial?

Witness: The water must go through one of two processes—it might improve or it might become worse; but I cannot conceive water under favourable conditions becoming worse—it must become better. In any case, whether it became better or worse as regards the presence of organic matter, it would undoubtedly become safer after the process.

If the water is impounded for a period of a week or a fortnight in one of these reservoirs, irrespective of whether or not it would become better or worse organically, it would be infinitely safer for town supply?—The answer to that question turns entirely upon the period of life of the pathogenic organism.

The Commission then adjourned to the 20th inst.

METROPOLIS WATER SUPPLY.

The Memorandum of the London County Council on the Future Water Supply and Population of the Metropolis.

Reference has already been made in the JOURNAL to the Memorandum presented by the London County Council to the Royal Commission on Water Supply, setting forth their views on the subject of the future water requirements and population of the Metropolis. It may be remembered that the Council came to three conclusions: "(1) That, in making any estimates having reference to the future water supply of London, such estimates should be based on a period of 50 years from the present time; (2) that, in dealing with the question of a source or sources of water which shall meet the requirements of London and its neighbourhood for 50 years, provision should be made for supplying a population of at least 12,500,000; (3) that in calculating the quantity of water required per head per day, the amount at present supplied by the Companies should be increased by at least 10 per cent., and in no case should it be less than 35 gallons." With regard to the first conclusion, the Council thought the expenditure to be incurred, in order to provide a supply for the period named, would, in the ordinary course, be spread over 60 years, and might very possibly be extended to a longer period; and therefore the requirements of all those generations of ratepayers who would be called upon to pay the cost must necessarily be provided for in making the outlay. As to the second, the Council considered that the Duke of Richmond's Commission in 1869 formed very erroneous conclusions as to the future population of the Metropolis. In their report, they stated that a probable increase of population to 4,500,000 or 5,000,000 might have to be provided for, though they believed that the time for such an extended provision would be very remote. The population at present supplied by the Water Companies already exceeds 5,250,000; and in view of this unforeseen increase, the greatest care would have to be taken to avoid any similar mistake in present investigations.

Dealing at length with this matter, the memorandum states as follows: In considering the population for which water must be supplied, it must be borne in mind that the demand will not be limited to the area of the county of London, or even to that of the present Water Companies. In all probability, if the London County Council becomes the Water Authority for London, it will be compelled to supply water to neighbouring populations. Thus the source of water from which London will draw must be large enough to enable it to meet these obligations. Calculations, therefore, as to future population must be based upon the growth of population over an area very much larger than that of the London county. The area of Greater London—*i.e.*, the Metropolitan Police District—is suitable to be taken for this purpose. Greater London is to a very large extent peopled by individuals whose interests and whose work lie in London and who are in reality Londoners. In considering the growth of Inner London during the present century, we are struck by the fact that until 1891 the population grew in every ten years at a rate varying between 16 and 21 per cent.; but that in the decade of 1881-91, this rate of increase fell to 10 per cent. The question arises as to the meaning of this change. Does it mean that London has reached the turning point of its numerical ascendency, and that in a few years the increase may become a decrease; or are there other causes which may be taken into account? This question is answered if we extend our observation over a larger area. If we notice the growth of the population lying immediately around the county of London, we find that it increased in the 10 years 1861-71 by 50·8 per cent., in the 10 years 1871-81 by 50·5 per cent., and in the 10 years 1881-91 by 49·5 per cent. Thus it appears: (1) That the diminution in the rate of increase in Inner London hardly holds good in the neighbouring area, and that therefore it cannot be taken as a sign of any general falling off in the population. (2) That other causes must be at work to effect this change. These other causes are: (*a*) The space available for building within Inner London is being rapidly appropriated; (*b*) the railway and other facilities of communication enable vast numbers of Londoners to live outside London. These considerations apply to Greater London in its turn as well as

to Inner London; and they account for the fact that Greater London shows a slightly diminishing rate of increase during the last decade. As people have moved from Inner to Outer London, so they are now moving from Greater London into the country districts of the home counties; and thus it may be fairly said that there are no signs to justify a conclusion that the population of London and its neighbourhood is tending to do otherwise than increase at much the same rate as hitherto. What rate of increase, then, shall be adopted in estimating for the future growth of London? If we consider that Inner and Outer London grow respectively at the rate of 1881-91, there will be in 1941 a population of 17,527,645. If we take the growth of Greater London at the mean rate of increase for the period 1861-91, there will be 14,312,007. If we assume that London will only grow at the rate of the natural increase of births over deaths, there will be 10,836,989; while if we merely add in each decade the numbers added since 1881, there will be 9,966,687. It is clear that under no consideration ought we to estimate the population in 1941 at less than 10,000,000. It is also clear that the last figure is too low, since it leaves out of sight all consideration of the usual rule that populations increase by annual additions of a certain given percentage. In view of the above considerations, it would not be prudent, in providing water supply for 50 years from the present time, to estimate the population requiring such a supply at less than 12,500,000.

As to the third conclusion, the memorandum states that, without the evidence of the Water Companies, it was impossible to know how much water is actually being consumed per head of the population. In estimating for 50 years, however, allowance should in any case be made for a more generous supply than now exists. The requirements for water are undoubtedly increasing, and will continue to do so as the need for luxuries increases, and as the laws of sanitation are more generally observed. Moreover, when the supply of water is in the hands of a municipal authority, much larger amounts will probably be used than at present for street cleansing, fountains, &c. Any scheme for providing London with water for the next 50 years will have to be based upon the supply of an ample quantity; and any amount short of 35 gallons per head would not be deemed ample.

MANCHESTER CORPORATION GAS SUPPLY.

Gas Committee's Annual Report.

The report of the Gas Committee of the Manchester Corporation for the year ending March 31 last has just been issued, together with the usual financial statements for this period; and we have received a copy from Mr. Charles Nickson, the Superintendent of the Department.

We learn from the report that the quantity of coal and cannel carbonized was 351,121 tons; being an increase of 4276 tons, or 1·3 per cent., on the previous year. There were transmitted from the works 3,404,678,000 cubic feet of gas; being 9695 cubic feet per ton of coal carbonized. The total quantity of gas measured and accounted for was 3,244,778,000 cubic feet; leaving for loss by condensation and leakage 159,900,000 cubic feet, or 4·7 per cent. The average illuminating power of the gas was 19·55 candles. There were 2568 gas cooking-stoves and gas-fires on hire, and 2274 owned by private persons; making a total of 4842 in use at the end of the year. In addition to these, there are about 591 gas-engines at work in the district. The whole of these gas-fires, cookers, and engines are estimated to consume about 125 million cubic feet of gas per annum; and the revenue from them is about £16,000 per annum. The increase in the quantity of gas consumed during the past year was 3·12 per cent. The number of gas consumers in the city is 65,418; the number beyond the city, 15,153—making a total of 80,571; being a net increase of 1092, or 1·37 per cent.

The Committee report that the financial results of the year's working were satisfactory. The total revenue of the Gas Department was £536,147. The amount of gas-rental was £398,086; being an increase of £8495, or 2·14 per cent., notwithstanding the reduction in price to the incorporated out-townships. The amount received for coke was £39,797, being £4052 less than last year; for tar, £33,437, being £2595 more; and for ammoniacal liquor, £23,363, or £599 in excess of 1890-91. Coal and cannel, including unloading, cost £234,284, or an average of 13s. 4·11d. per ton; being 1s. 0·25d. per ton more than last year. Retort men's wages amounted to £47,108, which was 2s. 8·2d. per ton of coal carbonized, as against £45,483, or 2s. 7·46d. per ton, last year. The gross profit for the year, after paying for wear and tear and renewal of works, was £114,611; and after deducting the fixed charges—viz., £26,379 for interest, £13,954 for the sinking fund, and writing off £9085 the balance of the public lamp capital account—the sum of £55,596 has been paid over to the city fund, and £9596 placed to the renewals account. The bad debts written off amounted to £477, or 1s. 9d. per cent. on the total revenue. In view of the resolution recently passed by the Council—viz., "That, having regard to the increase of the city rate for the current year, it is not expedient at the present time to reduce the price of gas as proposed in the Gas Committee's proceedings of the 26th of April, 1892"—the Committee do not make any recommendation as to the price of gas. They report that the additions to the manufacturing power and gas storeage at the several works, reported upon last year, have been pushed forward with all possible speed. By the extensions to the large connecting mains which are now in progress, the gas will be sent with facility from any one or more of the works, as convenient, into the district most requiring it.

With regard to the supply of electricity, the Committee have from time to time reported to the Council the various steps taken; and therefore they say it is only needful in their present report to state that Dr. John Hopkinson has been appointed Electrical Engineer; and, under his direction, plans and specifications of the several buildings and plant have been prepared, and contracts entered into. Land formerly used by the Highways Committee has been obtained; and the work in connection with the establishment of a central station is proceeding. The Committee anticipate that the result will be so satisfactory that the area of the supply may, in course of time, be greatly extended.

MANCHESTER CORPORATION GAS-WORKS.

Abstract of the Annual Accounts to March 31, 1892.

The following are some of the principal figures in the accounts of the Gas Committee of the Manchester Corporation, which accompany the foregoing report:—

PROFIT AND LOSS ACCOUNT.

EXPENDITURE.			Dr.
Cannel and coal (including cost of unloading, &c.)			£234,284 13 7
Retort men's wages			47,108 9 10
Retorts, fire-bricks, &c. (including cost of setting)			12,448 18 8
Repairs and maintenance of works, mains, &c.			44,676 3 8
Purifying material and wages			3,237 18 8
Salaries and wages of clerks in Superintendent's office, rental and inquiry offices, and meter inspectors			15,560 2 7
Collectors' salaries			7,158 19 6
Rents, rates, and taxes			19,321 19 7
Renewals of plant, &c.			20,393 2 9
Bad debts			477 5 9
Miscellaneous expenses			3,319 11 3
Lighting, repairing, and maintaining city lamps			13,548 11 8
			£421,535 17 6
Balance carried forward			114,611 17 6
			£536,147 15 0
Interest			£26,379 11 2
Sinking fund			13,954 0 0
Balance carried down			74,278 6 4
			£114,611 17 6

INCOME.			Cr.
Gas-rental			£380,587 19 6
Meter-rents			12,084 14 8
Stove-hire			972 13 10
Total cost of street lighting paid out of city fund—			
Value of gas	£26,136 10 3		
Lighting, repair, and maintenance	13,548 11 8		
		39,685 1 11	
Public lamps beyond the city		4,440 18 10	
Residual products—			
Coke	£39,797 7 9		
Tar	33,437 6 4		
Ammonia water	23,363 3 11		
		96,597 18 0	
Rents of cottages, &c.		251 14 3	
Balance of bankers' interest		1,526 14 0	
		£536,147 15 0	

The balance of profit was applied as follows:—	
Amount paid over to the city fund account	£55,596 0 0
Written off balance of public lamps capital account	9,085 6 11
Balance placed to contingent fund account for extraordinary renewals of plant	9,596 19 5
	£74,278 6 4

STATEMENT OF ASSETS AND LIABILITIES.

ASSETS.			
Gaythorn station—land, buildings, and apparatus			£202,069 1 11
Rochdale Road station			260,402 5 6
Bradford Road station			410,304 10 8
Droylsden station			14,393 5 9
Street-mains stores (Poland Street)—land, buildings, and apparatus			2,961 8 10
Street-mains			361,838 17 6
Service-pipes			62,294 9 8
Hired meters			79,698 18 1
Hired stoves			7,372 16 5
Cottage property purchase-money			1,652 13 6
Electric lighting—preliminary expenses			1,481 7 8
Total property			£1,404,469 15 6
Cannel, coal, retorts, and other material in stock			71,401 9 5
Gas-rents and other accounts due to the Committee			148,728 19 11
Cash in hand and at bankers'			9,214 12 11
Total property and assets			£1,633,814 17 9

LIABILITIES.			
Mortgage debt			£681,582 0 0
Sums advanced (not secured by mortgage)			1,430 0 0
Accounts owing for coal, &c.			39,559 3 2
Deposits held in security of gas-rents			34,955 4 3
Interest due thereon			4,432 16 7
Cash deposits for due performance of contracts			5,050 0 0
Amount payable on account of cottage property			1,600 0 0
Total liabilities			£768,609 4 0
Surplus and sinking fund, as per last statement	£830,386 10 0		
Transferred from profit and loss account for the year ended March 31, 1892	13,954 0 0		
		*844,340 10 0	
Contingent fund account—			
Amount as on March 31, 1891	£11,268 4 4		
Do. transferred from profit and loss account this year	9,596 19 5		
		20,865 3 9	
		£1,633,814 17 9	

* Of this sum, £688,411 has been applied in reduction of loans; leaving a surplus of £155,929 10s.

GENERAL SUMMARY OF THE CAPITAL AND REVENUE ACCOUNTS.

RECEIPTS.

Balance brought forward (see Summary, March 31, 1891)	£181,629	1 6
Loans received during the year	655	0 0
Amount received on sale of land, &c., at Bradford Road	531	2 8
Sinking fund, transferred from profit and loss account	13,954	0 0
Balance of profit and loss account (as per statement)	74,278	6 4
	£271,047	10 6

EXPENDITURE.

Loans repaid		£14,790	0 0
Amount paid over to the city fund account out of the year's profits		55,596	0 0
Expenditure charged to capital account		56,913	12 3
Stocks on hand	£71,401 9 5		
Gas-rents, &c., due	148,728 19 11		
Cash in hand and at bankers'	9,214 12 11		
	£229,345 2 3		
Less accounts owing to sundry creditors	85,597 4 0		
		143,747	18 3
		£271,047	10 6

The accounts proper are followed by the usual appendices, giving some interesting statistics as to the progress of the gas undertaking during the past municipal year.

The figures in Appendix A—a statement of the lamp and private rental, including meter and stove rents, derived from within and beyond the city—have already been given when dealing with the profit and loss account.

Appendix B is a comparative statement of the gas transmitted from the works in the daytime and during the twenty-four hours, for the past two years. Summarized, the figures are as follows:—

	Daytime. Cubic Feet.	Twenty-four Hours. Cubic Feet.
Year ended March 31, 1891	833,603,000	3,301,680,000
Do. do. 1892	883,190,000	3,404,678,000
Increase	49,578,000	102,998,000

	Cubic Feet.
Quantity of gas transmitted from works	3,404,678,000
,, measured and accounted for	3,244,778,000
Loss (by condensation and leakage)	159,900,000, or 4·7 per cent.

In Appendix C, particulars are given as to the results of the working from June 24, 1880, to March 31, 1892. The table contains statistics as to the number of tons of coal carbonized, the total make of gas, the yield per ton of coal, the illuminating power of the gas, the quantity of residual products, &c., for each year in the above-mentioned period. We have not space to reproduce all these particulars; but we give those for the past financial year. They are as follows: Coal and cannel carbonized, 351,191 tons; gas made, 3,400,831,000 cubic feet; yield per ton of coal carbonized, 9684 cubic feet; illuminating power, 19·55 candles; make, reduced to 20-candle power, 3,324,312,000 cubic feet; make per ton, 20-candle power, 9466 feet; make of coke, 224,202 tons; do. per ton of coal, 12·76 cwt.; make of tar, 23,693 tons; do. per ton of coal, 13·15 gallons; make of ammoniacal liquor, 8,803,197 gallons; do. per ton of coal, 25·07 gallons; make at 10-oz. strength, 8,619,135 gallons; do. per ton of coal, 24·54 gallons.

Appendix D shows the number of stoves and of each size of meter in use during the year in the city and out-townships. The particulars given are of special interest, as will have been seen by the references contained in the Committee's report. At the close of the past financial year, there were 3770 stoves in use within, and 1072 beyond the city—together, 4842. Of these, 1983 were on hire within, and 586 beyond the city (together 2568), as compared with 1715 and 530 (together 2245) at the corresponding date in 1891; so that there was an increase of 323. The numbers of the meters in use were 80,571 and 79,479 respectively; being an increase of 1108. There was, however, a decrease of 16; making a net increase of 1092. Of the total number at work on March 31 last, 69,949 were on hire, as compared with 68,394 at the close of the financial year 1890-91.

From Appendix E we learn that the gas-mains laid last year within the city amounted to 22,086 yards, and beyond the city to 5325 yards—a total of 27,411 yards, or about 15½ miles. The mains taken up were 10,925 and 712 yards respectively, or rather more than 6½ miles. The total net increase during the year therefore was 15,774 yards, or nearly 9 miles. The total length of mains laid at March 31 last was 1,217,056 yards, or 691½ miles.

Appendix F consists of a statement showing the amount of gross profit made from the gas undertaking, and the mode of its appropriation, from 1862 to March last. Some of the figures for the past financial year, and the totals for the 30 years during which the gas supply has been in the hands of the Corporation, are as follows:—

	Year ended March 31, 1892.	Total from 1862 to March 31, 1892.
Profit	£114,611	£2,561,325
Appropriation of profit—		
Interest	£26,379	£644,258
Liquidation of mortgage debt	13,954	737,920
Surplus	65,192	1,078,104
Street lighting (gas not included)	9,085	101,042
Paid over to Improvement Committee	£55,596	£1,057,238
Borrowed money owing	683,012	—
Amount charged to revenue for depreciation	—	721,435
Excess of assets	865,205	—

The Water Supply of East Ardsley and Alverthorpe.—Colonel Laurd, R.E., one of the Local Government Board Inspectors, recently held inquiries at East Ardsley and Alverthorpe into applications by the Local Authorities to borrow £1850 and £620 respectively for works required to improve the water supply. There was no opposition.

THE ELECTRIC LIGHTING OF BARNET.

Arbitration Proceedings.

The final stage in the long-standing dispute between the Barnet Local Board and their electric lighting contractor (Mr. Joel) has lately been reached in the arbitration proceedings instituted to determine the validity of certain claims made against that body for alleged breach of contract. It will be remembered that the lighting has been abandoned in favour of gas. The Arbitrators were Mr. FELL, for Mr. Joel; and Mr. SLATER for the Board—Mr. LUMLEY SMITH, Q.C., was Umpire.

Mr. ROBSON, Q.C., and Mr. COMPTON SMITH appeared for the contractor; Mr. F. MOULTON, Q.C., and Mr. J. W. GORDON for the Local Board.

Mr. ROBSON, in opening the case, said the Barnet Local Board gave Mr. Joel, by contract, a monopoly of the public lighting in the town for three years, and undertook to afford him the same facilities for obtaining private lighting as would be allowed to others. The tenure of private lighting being for seven years, Mr. Joel was practically granted a monopoly for this time, because, with plant on the ground for public lighting, he could keep out all competition. The main purpose Mr. Joel had in view was private lighting, for the terms under which the public lighting was done would hardly be remunerative; and, of course, it was his object to make a profit by his work. Mr. Joel was bound by the contract to put his wires underground; but the Board would neither allow him to place them there nor help him to get the authority of the Board of Trade to do so. He (Mr. Robson) suggested that the reason the Board took up this position was that they began to appreciate the fact that they had granted Mr. Joel practically a monopoly for private lighting by electricity such as the Gas Company had for gas. In consequence of the short time allowed to Mr. Joel, he, by consent of the Board, put up overhead wires; and any defects in the lighting were due to imperfections inseparable from such an installation. All things considered, however, the lighting was well done. He had only seven weeks in which to furnish the installation; whereas seven months would not have been too long. At first there was failure of a few lamps—about 20 out of 70—due to the non-delivery of certain plugs which had been ordered. When these came, all the lamps were lighted; but, in the interval, the Board wrote to Mr. Joel to say he had broken the contract, although it was apparent to everybody that the defects were trifling, and that he was doing all he possibly could. The lighting was commenced on Sept. 1, 1888; and on the 5th of October, the Board gave Mr. Joel 14 days' notice to terminate the contract. This notice was afterwards withdrawn. The defects were largely due to maliciousness, and to accidents due to overhead wires, for which the contractor was not responsible. A record of all the failures was kept; and when Mr. Joel presented accounts for payment, deductions were made in this respect. The figures were: 1888-9—Account, £383; deductions, £12; 1889-90—Account, £390; deductions, £1 5s.; 1890-91—Account, £400; deductions, £2 18s. 6d. The total deductions for the three years amounted to £16 3s. 6d., which certainly showed that the defects were but trifling.

The UMPIRE: I suppose the Board claim that they are entitled to say: This has been going on month after month, and therefore you are not fulfilling your contract?

Mr. ROBSON: They never gave us a fair chance; and then they also mistook their remedy under the contract. If there were defects, they should have given notice of them, so that Mr. Joel could have applied remedies. They would not allow him to perfect the installation by placing wires underground, and yet they complained of defects.

Mr. SLATER: If defects were due to bad wires, bad connections, and bad lamps, failures would not depend upon overhead or underground wires.

Mr. ROBSON: No. But here were the Board tying Mr. Joel down to a temporary installation, and then complaining that it was not so perfect as a permanent one.

The UMPIRE: You also claim, I think, that the Board were under an obligation to consent to the transfer of this contract to a company; and were bound, under all circumstances, to assist Mr. Joel in getting a Licence from the Board of Trade?

Mr. ROBSON: Yes; and we further claim that our losses are directly due to the Board binding us down to a temporary installation, and refusing to give us that assistance in getting a permanent installation which by the contract they agreed to do. Counsel then passed on to refer to Mr. Joel's claim, and read the following details:—

(1.) Actual loss sustained to April 30, 1891, due to breach of contract by the Board, whereby the contractor was obliged to maintain street lighting with a temporary overhead current only	£953	18 4
(2.) Estimated loss on forced sale of plant at the end of three years from the date of contract, instead of continuing to use such plant for purposes of private lighting	824	12 0
(3.) Interest at 5 per cent. on £953 18s. 4d.	47	13 10
(4.) The contractor will claim compensation for loss of profit he would have made during the foregoing period, up to April 3, 1891, but for the breach of contract on the part of the Board, at £500 per annum for two years	1000	0 0
(5.) Rent, rates, and taxes for premises during the remainder of the lease (five years); upkeep of premises during that time; rent, rates, and repairs, £85	425	0 0
(6.) The contractor will also claim for the profit he would have made from private lighting after April 30, 1891, but for the breach of contract, at £500 per annum for four years	2000	0 0
Total	£5251	4 2
Alternatively the contractor claims items 1, 2, 3, and 5, as above	£2251	4 2
(7.) Loss of profit through non-completion of transfer to the United Gas Improvement Company, as per agreement (there are also other negotiations and offers made to the contractors for the purchase of their rights under the said contract), subject to the performance by the Local Board of the contract	1000	0 0

(8.) Further prospective profits to be paid as commissions, at 10 per cent. per annum, for concessions on a formation of a company to take over the Barnet and other concessions	2000	0	0
(9.) Loss of salary as Managing Director of the proposed Syndicate Company and Technical Adviser to the English Company	500	0	0
Total	£5751	4	2

The following evidence was then given:—

Mr. *J. Pratt*, accountant, of Hanover Square, said he formerly resided in the neighbourhood of Barnet; and he was so satisfied with the light that he made a suggestion to Mr. Joel with the object of forming a syndicate to take over the contract.

Mr. *H. F. Joel* said he had large experience of electric lighting, and had fitted up many installations. He used overhead wires at Barnet with the consent of the Local Board; there being no time for placing them underground. A few days before he commenced the lighting, he attended a Board meeting, and informed the Board that he wished to have the contract transferred to a company. The Chairman did not make any objection, and said the application should be in writing—it was provisional consent. By Sept. 18, 1888, all the lights were in operation. On the 12th of September he put in a new dynamo, which broke down owing to the firing of a bearing; and when the old dynamo was got to work again, this also broke down. The probable cause of this was interference with the wires, by which the current ran to earth; and an armature broke as the result of consequent strain on the dynamo. He had no knowledge of any failures, except those mentioned in the course of correspondence—no others being brought to his notice; and in regard to these the Board made deductions when he sent in his accounts. The deductions covered the failures. Oftentimes failure of particular lamps was due to their breakage. The wires were constantly interfered with.

The UMPIRE: I suppose there is no clause in the contract absolving the contractor from performance if somebody nailed up a wire?

Mr. ROBSON: No; but I shall show that the Board, by their action, kept in operation a system which could not be satisfactory as a permanent one.

Mr. MOULTON: Let the facts speak for themselves. There were constant failures. It would be absurd to suggest that members of the Board went round with ladders interfering with wires and lamps, although what is alleged might possibly have been done by discharged workmen. However that may be, we can only look at results. You contracted to give a certain light, and you did not give it.

Mr. ROBSON: If we did not, you had your remedy in a claim for damages or for specific performance; and no such claim has been made.

The UMPIRE: The Board considered they had the right to go back to gas at the expiration of the three years' contract?

Mr. MOULTON: Yes; for reasonable cause.

Mr. *Joel*, continuing his evidence, said he ordered Bernstein lamps of 32-candle power, and a mixed lot were sent—some 50, but all over 32-candle power. This accounted for variation in the light afforded by the lamps at the beginning; but it was impossible in practice, even with lamps of the same standard, to get perfect uniformity, unless all had been burning the same number of hours. The carbons wore out. The 32-candle lamps in this instance were exhausted twice as fast as they should have been, owing to his having to run sufficient current for the 50-candle lamps on the circuit. In view of getting the Board of Trade Licence for putting wires underground and supplying private lighting, he, in March, 1879, took a seven years' lease of the engine-station, and improved the works by re-building; and after spending £2000, the Local Board refused to assist him, as they had by the contract undertaken to do. He negotiated with the United Gas Improvement Company to take over the contract; and they actually sent £600 worth of plant to Barnet. In consequence, however, of the Local Board withholding their consent, the thing fell through. In 1890 he gave the Board a second notice of his intention to apply for a Licence, and asked their assistance under the contract. They replied that they saw no reason "at present" for proceeding with the matter. He regarded his position at Barnet—the marketable concession which was his under the contract—as worth £3000.

In cross-examination by Mr. MOULTON, witness said the loss of £953 on the three years' working was his loss, although the business was transferred to the Barnet Electric Supply Company. Eighty £10 shares had been allotted in the Company, and paid up; there was a sum of £750 in debentures; and in April, 1891, there was an indebtedness of about £1000. The Company never possessed property more than would cover the debentures. The Local Board recognized him only; the Company was a matter for convenience, and was dropped except in name. The electrical system he adopted was used for the first time for public lighting at Barnet. If he had put in lamps for private lighting, he must have had a separate conductor, because the Board of Trade would not allow such a high voltage in houses as he used for the street lighting. It was quite practicable with his system—a series system—and with overhead wires to supply an entirely satisfactory light for street purposes, and also to give satisfactory indoor lights; but for the latter, whether supplied by overhead or underground wires, there must be an entirely separate installation. Overhead wires were not suitable for installations. He knew, when he signed the contract, that he was going to put up these wires; and they would have answered very well for six months. He could not give any reason why, if good for six months, an overhead installation, properly attended to, would not be good for a longer period. He could not name a single thing which, if done properly to last six months, would not have lasted for three years. The only interference he had had from the Board of Trade was that he was required to remedy certain defects. The Board relaxed rules in his favour. Under the contract, he was to provide three all-night lamps at junctions of streets; but he never did so. In a series system, the whole of the current passed through each lamp; and the current and the lamps were so arranged that, when the former was turned on, the latter gave their standard light. A lower current would not give the light; a higher one would spoil the lamps. It was therefore never practicable for him, by the use of accumulators, to provide the all-night lamps he contracted to supply.

Mr. SLATER: The contract allowed you to keep overhead wires for one year after the termination of the contract; so that the contract had in view the possibility of overhead wires remaining for some time, and yet you put an overhead system which you say would not be effective for more than six months?

Witness: It was a temporary system.

In further cross-examination by Mr. MOULTON, witness said that up to November, 1889, he worked with a portable engine; after that he had a stationary engine and dynamo. He had received written application for 1759 private lights, and verbal ones for 509. He could not bring forward any written contracts, or copies of letters he had written, in respect to applications for private lighting; but he produced a list, and could prove it, by himself or by his servants.

Mr. *A. Saunders* said he was consulted in August, 1889, by his clients, with a view to an arrangement being entered into with the United Gas Improvement Company, of Philadelphia, for a Syndicate to work the Heisler and Joel systems in combination, and to take over the Barnet works and contract. It was intended to experiment with the former system at Barnet; and, if found satisfactory, to take over and work certain patents. The thing did not go forward.

Mr. *J. J. Wheeler*, an electrical engineer formerly employed by Mr. Joel at Barnet, and Mr. *P. Mossop Potter*, an electrician in partnership with Mr. Joel, were called to speak to the satisfactory nature of the installation. They stated that failures were few, and were largely due to malicious interference with the wires; that the circuit was regularly tested each day to prove it before it was time to start the lamps; and that the lamps were regularly examined.

Mr. *Probert*, assistant to Mr. W. H. Preece, F.R.S., Electrician to the General Post Office, was next called, and examined in reference to photometric measurements he had taken of the illuminating power of the lamps. They showed that the lamps were unequal, and were not up to 32-candle power; but, on the whole, having regard to the nature of the plant, he regarded the light as fairly good.

A report by Mr. Preece was put in, in which, while criticizing the plant and the installation generally, he said he was satisfied with the light, but regretted that "so interesting an experiment" should be jeopardized by plant incapable of a reasonable extension of the lighting.

About a dozen other witnesses were called to speak to the satisfactory character of the light and the marketable value of the contract to Mr. Joel.

A large number of witnesses were called on behalf of the Local Board to speak to the failure of the light generally—total failure on occasions, frequent failure of particular lamps, and inequality and insufficiency in the lighting.

Mr. *J. Swinburn*, an electrical engineer, said the price at which Mr. Joel took the contract—£5 8s. a year for 32-candle lamps, as against £2 17s. 6d. for 16-candle gas-lamps—could not possibly pay him. The gross income for three years was £1042; whereas the outgoings were 50 per cent. more than this sum. As to private lighting, it was impossible for electric light to compete with gas in point of price.

Mr. *C. Stevens*, Chairman of the Local Board, said the electric lighting was unsatisfactory from beginning to end. The Board showed Mr. Joel every indulgence; but it was impossible that they should do anything to prolong his hold on the district beyond the three years of his contract. They were anxious to adopt the electric light; but Mr. Joel either would not or could not supply it to their satisfaction, and according to the contract.

Mr. *Holloway*, a draper of Barnet, said he spoke to Mr. Joel about lighting up his shop; but he certainly gave no order, either implied or expressed. Mr. Joel's price would have been £60 a year; whereas he paid only £25 for adequate gas lighting.

Mr. MOULTON, in addressing the Court, laid special stress upon the alleged breach of the contract by the Board. If, he said, the contract had been broken, it was on public grounds. Mr. Joel having failed to light the streets satisfactorily, it would have been undesirable, in the interests of the public, to help him to acquire powers for private lighting. The fair meaning of the contract was obvious; and the Board acted *bonâ fide* in not helping Mr. Joel to get a Licence, because he was not doing his work properly. There was absolutely no evidence of damage to him, and no ground whatever for saying that the cost of carrying out the contract had been in any way increased by what the Board had done.

Mr. ROBSON, in reply, said it was obvious that Mr. Joel's purpose was to get private lighting, and so have something profitable. It would have been sheer madness to take the public lighting only at the contract prices. The Board had a remedy, by way of damages, if Mr. Joe made default; but they had no justification for refusing to carry out the contract by assisting him to obtain a Licence from the Board of Trade. The concession granted to him by the contract was clearly a marketable interest; and he was entitled to recover from the Board the profit he might reasonably have made on sale to a company, if the Board had not stood in his way.

The proceedings then closed.

The Umpire made his award on the 1st inst.; giving Mr. Joel £500 and costs. The amount was awarded generally, and not on specific items of his claim.

The New Water-Works for Colchester.—At the meeting of the Colchester Town Council last Wednesday, the Water Committee recommended that application should be made to the Local Government Board for sanction to borrow £12,000 for executing certain works in connection with the water supply. Mr. Paxman reminded the members that six months ago they passed a resolution authorizing the expenditure of this money, which, though borrowed, would not come from the ratepayers, but from the water consumers. The income from the water-works had increased as the requirements of the town had grown; and to-day the works were not equal to what was required of them. By the time the proposed new works were finished, there would be a revenue of £8300 a year, and an expenditure of £7131; so that there would be year after year a clear £1000, after paying all expenses of the loan and allowing for depreciation, to hand over to the ratepayers for a reduction of rates. The recommendation was adopted.

LEEDS CORPORATION GAS SUPPLY.

The Salary and Duties of the Superintendent of the Department.

At the Meeting of the Borough County Council of Leeds last Wednesday, Alderman Gilston moved that the salary of Mr. James Lupton, the Superintendent of the Gas Department, be increased from £350 to £400 per annum. He said that Mr. Lupton was well known to every member of the Council. He had been a servant of the Corporation since 1870, when they purchased the gas-works. He commenced with a salary of £250; and in 1877 it was advanced to £350. The duties and responsibilities of Mr. Lupton's office had increased more than fourfold since 1877; and he had discharged his duties to the satisfaction of the Committee. Mr. Willey seconded the resolution. He said that, in his opinion, Mr. Lupton was one of the few responsible officers of the Corporation who were underpaid. In every respect he was a most admirable servant, and did his very best in the interests of the ratepayers. Mr. Lowden remarked that he did not want to disparage Mr. Lupton in any way. He believed that he was a good, conscientious servant to the Corporation; but it was a curious thing that the Borough Accountant should have the control of all the finances of the Corporation except those of the gas-works. A Sub-Committee had been appointed to consider the question; and he moved that the matter be referred back to the Gas Committee, so that the Sub-Committee to which he had alluded might see if they could agree upon some plan which would place the finances in the hands of the Borough Accountant. Mr. Wilson, in seconding the amendment, observed that he was strongly of opinion that the Borough Accountant ought to be placed in the same position in connection with the gas-works as he was with regard to the water and other departments of the Corporation. Mr. Henry considered this a most unfair proposition. It had nothing to do with Mr. Lupton's salary at all. An interview did take place between Sub-Committees of the Gas Committee and the Finance Committee on this matter, and an understanding was come to. He was favourable to giving Mr. Lupton an advance in his salary, and some reduction in his work, because he believed at his time of life this was necessary. For an office such as his, £350 was a very small salary. Mr. Moody said that, as an old member of the Committee, and knowing the worth of Mr. Lupton, he should like to have given him £100 advance. There was a feeling that he had been insufficiently paid for his services. Other gentlemen having also spoken highly of the services rendered to the Corporation by Mr. Lupton, Mr. Lowden said he did not want that gentleman's position jeopardized by any action of his, and, with the permission of the Council, he would withdraw the amendment. This was agreed to; and the resolution was then carried, with a few dissentients.

CAPE TOWN AND DISTRICT GAS COMPANY, LIMITED.

The Adjourned Ordinary General Meeting of this Company was held last Friday, at the London Office, Winchester House, E.C.—Mr. H. R. SAVORY, in the absence of the Hon. Henry Noel, presiding.

The CHAIRMAN said that at the meeting held on the previous Friday (*ante*, p. 36), they were unable to pass the report as there was not a quorum of shareholders present; but, as they had now complied with the Articles of Association, he would move its adoption.

Mr. FAIRCLOUGH seconded the motion.

Mr. FOX asked if the Directors intended, in the existing state of affairs, to continue receiving the large fees they were drawing. He was aware that they were entitled to take the money under the Articles of Association. But that could be dealt with by special resolution; and he should adopt the best means in his power to get one passed to alter it, if the Directors still took the money. He believed he held a larger number of shares than any Director, excepting one. He saw that one Director only possessed 50 shares, instead of 100; and he did not know that he was qualified to fill the position.

Mr. FAIRCLOUGH observed that the qualification for the local Board of Management was £250 in shares; and they were paid £300 per annum, divided between three members.

The CHAIRMAN, in reply to a further question, said that the four London Directors received £1200—the Hon. Henry Noel (the Chairman) £450, and the other Directors £250 each.

Mr. PAYNE remarked that he understood a gentleman had been sent out to the Cape to teach the Company's representatives book-keeping; and he thought, if the local Directors were capable men, they could have supervised this work. He also inquired what amount of new capital it was contemplated to raise; and observed that he had no idea, when he became a shareholder, that the Company were buying such a rotten concern as the Chairman had described at the previous meeting.

The CHAIRMAN stated that, when the Company's present officials went out to the Cape, they found the book-keeping of the old Company was practically *nil*; and one of the principal reasons for Mr. Lass visiting Cape Town was to arrange the books and accounts on a proper basis. With regard to new capital, nothing definite had yet been done; and it was now a very unfavourable time for raising fresh capital. As to the remark about the rotten property, he thought that the Chairman had, in his speech, drawn the picture as black as he could.

Mr. Fox said there seemed to be a good deal of money waiting investment; and, unless there was something unfavourable in the condition of the Company, he should have thought this was not at all a bad time to raise capital. He supposed the Company was promoted by the Gas, Water, and General Investment Trust.

The CHAIRMAN replied that it was. Being pressed to answer Mr. Fox's question as to the intention of the Directors respecting their fees, he said that, speaking for himself and Mr. Fairclough, they would reconsider the question of their remuneration; and this would apply to the past.

An amendment was then moved by Mr. Fox, to the effect that the report should simply be received; but this was negatived, and the motion was carried.

The retiring Director (Mr. Boustead) and the Auditors were re-elected; and this concluded the proceedings.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

At the last meeting of the Edinburgh and Leith Gas Commissioners, applications by six subordinates on the staff of the Commission for increases of salary were read out; and the subject was remitted to the Finance and Law Committee. If heed is to be paid to a couple of anonymous writers in the local press, there were also applications by Mr. Gibb, the Treasurer, and Mr. Cockburn, the Collector, for an increase of salary. If these gentlemen have sent in such applications, the Clerk did not make them public; and I think they ought to have been read out along with the others, and so have avoided the giving rise to odious comparisons such as the writers of these letters have thought fit to indulge in. Their remarks are not worthy of notice. But, assuming that the gentlemen named have applied as stated, something may be said on the subject; and I think the assumption is a safe one, because there is every reason to believe, from internal evidence, that the writers of the letters are gentlemen employed in the office of the Gas Commissioners. The burden of the complaint of the anonymous writers is that there should be any proposal to increase the salaries of the higher-paid officials; and the plea is put forward, by implication, that it is the clerks and lower-paid men on the staff who should get an increase. This may be disposed of with the remark that the lower-paid men presumably get the market rate of pay; and that any increase of business does not lead to additional work for them, but to an increase of their number. With regard to the officials at the head of the undertaking and the heads of departments, there is this to be borne in mind, that an increase of business means more work and greater responsibility. Now, a reference to the annual accounts of the Commission, shows that the revenue from gas has increased from £197,612 in the first full year of the Commission to £270,917 last year. Other responsibilities have increased proportionately; and surely it is time that the question of the remuneration of the heads of departments should be reconsidered. When the Commission came into existence, I have no hesitation in saying these gentlemen were underpaid—on account of, first, the desire of the Commissioners to walk cautiously until they saw how affairs were to turn, and, second, because the late Mr. J. K. Watson, who was Manager and Treasurer of the Edinburgh Gas Company, derived a pension of £1200 a year from them. Mr. Watson, to the regret of all who knew him, has been removed by death; and the Commissioners are thereby relieved of an outlay of £1200 a year. Considering, along with this, the favourable return of last year, this is certainly an appropriate time for overhauling the remuneration of the two gentlemen who do Mr. Watson's work. There is another argument for increased remuneration to the Treasurer and Collector, in that had the Companies continued in existence, the cost of management would have been much higher than it is. I may also be permitted to add that the Commission, in Mr. Gibb and Mr. Cockburn, possess two officials of undoubted capacity and devotion to their work, which is another reason why they should be well remunerated. The Treasurer's department is perfect; and as for the Collector's, the working of it is magnificent, the proportion of uncollected debts being the mere trifle of only a shilling or two per cent. It is to be hoped that the Commissioners will disregard all outside clamour or internal dissent, and do their duty—which is to see that those who are responsible for the conduct of their business are paid according to the rates which rule in other places, and I understand the Edinburgh officials are not so paid at present.

The Aberdeen Town Council have resolved not to contract for their whole year's supply of coal at present, but only for half the quantity they require. This resolution has been adopted in the expectation that, before other six months are over, there will be a further fall in the price of coal. I believe they are right; everything is pointing in that direction. It is evident there has been a great shrinkage in the volume of the iron trade, which is one of the trades that consume coal largely. This was brought out recently by Mr. W. Jacks, of Glasgow, in a paper which he read before the British Iron Trade Association, in which he showed that last year there was a decrease to the amount of 19 per cent. on the sale of British iron goods in the neutral markets of the world; whereas the sale of German goods of the same class had increased by 21 per cent. Such a statement must be a bitter pill for the organizers of workmen's unions, who care for nothing except how they can screw the wages of the workers up. Falling markets, however, cannot be resisted; and if trade is being lost, wages must come down. The increased wages of the miners has been the cause of the high price of coal during the past few years; and a reduction in them would mean cheaper coal. The indications of slackness in the demand for coal are not very pronounced yet. But there is one very significant indication; and that is that in Linlithgowshire this week a coal pit has been closed. There is another indication that straitened times for workmen are imminent, to be found, very strangely, in the remarks of Mr. Gladstone to his constituents at West Calder on Thursday. The works of Young's Paraffin Light and Mineral Oil Company are situated in the neighbourhood of West Calder; and the Right Hon. gentleman had presented to him privately a petition from the oil-workers asking him to support a movement for the imposition of heavy duties upon imported oils. Mr. Gladstone declined, on Free Trade principles, to be a party to taking such a step; but he mentioned, what was not known before, that there was very considerable distress among the oil-workers. The inference is that, if distress has already begun to manifest itself among the oil workers of the Young's Company (which is the only oil company in Scotland that has been able to pay a dividend this year), the oil industry must be in a very bad condition. Oil making is not merely a twin industry to that of coal getting, it is to a large extent the same; and if the wages of the shale miner go down, the wages of the miner of ordinary coal must follow. There is thus every prospect of coal being cheaper; and it looks as if it were wisdom on the part of the owners of gas undertakings not to enter into long contracts at present. In the Town Council of Aberdeen, one member strongly objected to the resolution of the Council. But that is nothing. There are foolish people in every community. The good sense of the Council, however, prevailed. The Councillors had a talk, initiated by

Bailie Lyon, upon the illuminating power of the gas now supplied. It has been recently as low as 20·57 candles, which Bailie Lyon thought was far too little, and led to gas bills being higher. His remarks were exceedingly ill-advised, as the Gas Committee have had unusual difficulties to face. But it is gratifying to observe that he received only scant encouragement in his complaint; the sensible remark being made that he himself should be put upon the Gas Committee.

The Hamilton Town Council received 26 applications for the post of Manager of their gas-works, which was vacant owing to the death, in May last, of Mr. John Johnstone. The list was reduced to five by the Gas Committee, and submitted to the Council on Thursday night, with a unanimous recommendation that Mr. William Ewing, of Middleton, Cork, should be appointed. This was agreed to.

The Bothwell and Uddingston Gas Company, at their annual meeting the other day, declared a dividend at the rate of 10 per cent. It was stated that during the past year they manufactured 23,615,600 cubic feet of gas, and sold 21,132,500 cubic feet—an increase of 997,100 cubic feet over the quantity sold the previous year. Their revenue was £4889; and the balance of profit, £1284. The Motherwell Gas Company had an income last year of £6447, and an expenditure of £4592. The dividend paid was at the rate of 7 per cent. The Brechin Gas Company this year have reduced their dividend from 35s. to 25s. per share; and to pay this they have had, in addition to utilizing the balance of profit, to take advantage of £247 of interest upon the contingent fund, and to withdraw £229 from the fund itself. They have also been obliged to raise the price of gas from 4s. 4½d. to 4s. 7d. per 1000 cubic feet. The Crieff Gas Company have paid a dividend at the rate of 5 per cent. and a bonus of 1s. per share, which is equal to another 5 per cent. They have also resolved to expend £1040 on alterations at the gas-works.

The pressure which gas-works are experiencing in the matter of the sale of residual products, is easily understood when it is stated that, within the past few years, since it has become the practice to recover tar and ammonia products in connection with iron-works, as much as £70,000 worth of plant has been laid down at such works in Scotland for the recovery and treatment of these products.

It is very seldom indeed that one hears of a Gas Company ceasing to supply gas and closing its works. Such an event has taken place this summer at New Pitsligo, an Aberdeenshire village of 2000 inhabitants, where the gas-works have been closed for about two months. There seems to be great apathy among the shareholders, doubtless arising from unprofitable business, as they would not even attend a meeting when they were several times asked to do so, to consider whether or not the Company should continue to exist. A meeting of the leading inhabitants, however, was convened the other day by the Lord of the Manor, who expressed his wish that the gas supply should be continued. The proposal met with acceptance; and a Committee was appointed to endeavour to form a new company under the Limited Liability Act.

The Dundee Water Commission on Thursday approved of the estimates of the Finance Committee for the current year, and fixed the charge for water for domestic purposes at 1s. per pound. This is a very high figure; but, as is well known, the Commissioners have been led into great additional expenditure by the necessity for duplicating their mains. The original cost of the Lintrathen works was very heavy; and when, in a few years, the burden of the capital account might have been considerably lightened by the repayment of borrowed money, the cost of the duplication comes in, and the day of a light water-rate is removed to a period in the future which is not yet within the range of vision. In moving the adoption of the Finance Committee's report, Mr. Doig, the Convener, warned the Commissioners that, if they entered upon any new works of magnitude this year, the all but inevitable result would be an increase in the rates. The expectation is that nothing more will require to be done in the way of augmenting the water supply for many years. In the estimates for the year, while increases in the revenue have been calculated on a very moderate scale, liberal allowances have been made for expenditure; so that the estimated surplus of £64 should be attained.

Referring to our correspondent's remarks in the first paragraph of his "Notes" last week, Mr. Adam MacPherson, the President of the North British Association of Gas Managers, writes: "It is implied that the changing of the place of meeting of the North British Association of Gas Managers, from Dundee to Stirling, would not meet with Mr. M'Crae's approval. I wish to state that, far from such being the case, it was on the motion of Mr. M'Crae that the Committee agreed to the change. I may also say that, so far as the Committee know, there never was any attempt on the part of the Corporation of Dundee to interfere in any way with the arrangements for the unveiling of the bust of Murdoch, far less to dominate these proceedings."

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *July* 9.

Sulphate of Ammonia.—The market continues to improve; but by very slow stages. This may be due to the fact that the interest of the dealers lies in the contrary direction, and this opinion is corroborated by the low quotations emanating from this quarter; for, while second-hand parcels are still quoted at £9 16s. 3d. to £9 17s. 6d., makers are realizing about 2s. 6d. per ton more. One prominent factor must, however, remain undisputed; and it is the almost unprecedented reduction of the stocks, which seem at the present moment to be at a lower level than ever experienced before. It may be argued that the bulk of the demand will not set in again till nearer the autumn; but there are other significant symptoms that requirements for July and August are by no means satisfied. The struggle, however, between seller and buyer can, from the present standpoint, end only in the discomfiture of the latter. Nitrate remains firm, and values unchanged.

LONDON, *July* 9.

Tar Products.—Business has been very quiet during the week. It is reported that a quantity of anthracene has been sold; but the price so far has not transpired. Anthracene appears to be without any life, notwithstanding there is a little more inquiry; and the tendency is to lower prices. Tar contracts continue to be let at prices ranging from 8s. to 12s.; but, in the latter case, exceptional circumstances as to quality and position exist. Carbolic acid, if anything, is quotable better; and, as there are no stocks, if an abnormal demand arose from cholera or for other sanitary purposes, it might return to healthier and more profitable prices. Benzols are dull and unsaleable; but the demand for pitch does not appear to fall off as was prognosticated. Business has been done at: Tar, 8s. to 12s. according to position and quality. Pitch, 28s. Benzols, 90's, 1s. 8d.; 50's, 1s. 4½d. Toluol, 1s. 2½d. Solvent naphtha, 1s. 3d. Crude benzol naphtha, 30 per cent., 8d. Creosote, 1d. Naphthalene salts, 20s.; pressed, 45s. Carbolic acid, crude 60's, 1s. 1d.; 70's, 1s. 4d.; crystals, 5d. Cresol, 8d. Anthracene, 30 per cent., "A" quality, 10d.; "B" quality, 7d.

Sulphate of Ammonia.—There is not much doing; but buyers are firm in their ideas of value. There are no important stocks in existence; and the low prices which have obtained during the past six months has brought buyers from other previously unsupplied countries. Sulphate has undoubtedly touched bottom; and better values are sure to be procurable shortly. Business has been done during the week at prices ranging between £9 16s. 3d. and £10, less 3½ per cent. discount. Gas liquor (10-oz.) is quoted at 5s. 6d. to 6s. 6d.

COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—So far as all descriptions of round coal are concerned, business continues to move on slowly; supplies are in excess of requirements, and stocks at a number of the collieries are accumulating—although not to any large extent. Quotations remain on the basis of 12s. to 12s. 6d., for best Wigan Arley; 10s. to 10s. 6d., for Pemberton four-feet and second qualities of Arley; and 8s. 6d. to 9s. per ton, for common house-fire coals at the pit mouth. As pointed out in previous reports, the most unsatisfactory section of the trade is in connection with the commoner qualities of round coal, which usually go into consumption for iron-making, steam, and general manufacturing purposes. The lessened activity in the important coal-using industries of this district, is necessarily throwing a good deal of steam and forge coal upon the market; and prices are easier, although there is no actually general announced reduction of list rates. For inland sales, good ordinary qualities of steam and forge coal do not average more than 7s. 6d. to 8s. per ton; and surplus supplies are being pushed for sale for shipment, with the result that very low figures are ruling at the ports on the Mersey. The competition from outside districts with regard to gas coal contracts, to which reference has previously been made, is gradually weakening the position of the Lancashire colliery proprietors. This competition comes mainly from Yorkshire; and the explanation put forward is that, the Durham coal-owners having considerably reduced their prices for gas coal, Yorkshire colliery owners are being forced into this district to dispose of supplies which they cannot now get rid of in the Northern markets. Many of the principal contracts in this district have already been settled; but a number of others are pending, and buyers seem to be pursuing a policy of holding back as long as possible, with a view of obtaining amended tenders at lower prices. Concessions of 3d. per ton on last years' rates are now very general; and, in many cases, where there has been any special pressure, there is a giving way of 6d. per ton and more, whilst Yorkshire coal is quoted at reductions of 9d. to 1s. per ton upon last year's prices. As an illustration of this, it may be mentioned that in one instance, where a leading Yorkshire colliery firm has for 20 years had an uninterrupted contract for the supply of gas coal, they are this season being cut out by another Yorkshire firm. As the colliery which previously held the contract could have obtained a renewal at a concession of 6d. per ton upon last year's prices, it is evident that the successful tender must have been based upon terms something more favourable than this to the buyers. Engine classes of fuel continue in generally brisk demand; and the lessened quantity of round coal now being screened is producing rather a scarcity in some of the better qualities of slack. This is naturally giving a hardening tendency to prices; and in some instances slight advances have been quoted upon last month's rates. At the pit-mouth, ordinary qualities of burgy average 6s. 6d.; best qualities of slack, 5s. to 5s. 6d.; medium sorts, 4s. to 4s. 6d.; and common descriptions, 3s. 3d. to 3s. 6d. per ton.

Northern Coal Trade.—The coal trade for the last few days has been rather easier; the effect of a full production of coal at a time when the consumption is usually low, telling on the price at last. Best Northumberland steam coals are quiet; the nominal price being about 10s. per ton, free on board. Sales are, however, taking place at rather lower rates. Small steam coals are weak in price, at from 4s. 3d. to 4s. 6d. per ton; and there is a plentiful supply. Gas coals are at about their normal output; and there is as yet a full demand—some of the more important gas companies drawing in large quantities to stock with. The figures vary from about 8s. to 9s. per ton, free on board, less discount; and the medium price may be said to be that which is more generally asked. The consumption is beginning to increase, but is as yet relatively small. Smithy coals are being very freely exported; and a comparatively high price is asked. Coke is beginning to fall in price. For export, as high as 17s. per ton has been paid; while from this figure down to about 16s., free on board, may be taken as the ruling rates. For local consumption, prices are lower in proportion. Gas coke is steady. Stocks are small; but the production will now begin to increase, though not very rapidly for a month or so.

Scotch Coal Trade.—Except that it is almost in a state of stagnation, owing to the political turmoil of the week, there is little to say about the coal trade. The business done has been for prompt delivery, forward orders being all but unknown. Prices have remained stationary. What the course of trade may be when the country settles down after the General Election, it is impossible to guess at. All that can be said is that, unless the demand from the Baltic ports sets in soon—and of that there is as yet no appearance—an easing off of prices may be looked for. The prices quoted are: Main, 7s. 9d.; ell, 8s. 6d.; splint, 8s. 3d. to 8s. 6d.; and steam, 10s. to 10s. 3d. per ton, all the

same as last week. The shipping returns, which have shown such wonderful vitality during this season, have now begun to recede; many orders going, doubtless, to North of England ports. For the week, the quantity exported was 143,018 tons—a decrease, as compared with the previous six days, of 5089 tons, and of 816 tons as compared with the corresponding week of last year. For the year to date, the total quantity exported has been 3,644,388 tons—an increase of 540,853 tons.

Increase in the Price of Gas at Blackburn.—The Blackburn Town Council last Thursday approved of the recommendation of the Gas Committee to increase the price of gas used for lighting purposes by 2d. per 1000 cubic feet, subject to discount as hitherto. The change takes effect as from the 1st inst.

Sale of Shares.—At the Auction Mart, Tokenhouse Yard, on Wednesday last, Messrs. Edwin Fox and Bousfield sold by auction 600 new £50 shares in the Grand Junction Water-Works Company (maximum dividend 7 per cent. per annum). Of these, 18 sold at £86 10s. each; 118, at £86; 176, at £85 10s.; 14, at £85 5s.; 174, at £85; 10, at £84 10s.; 64, at £84; and 26, at £83 15s.

Accident to a Large Water-Main at Birmingham.—On Thursday afternoon it was discovered that one of the joints of a 36-inch main, which conveys water from Whitacre to the high-level reservoir at Erdington, in connection with the Birmingham Corporation Water Supply, had given way; and, before it could be temporarily stopped, 3 million gallons of water found their way into the River Tame, causing it to overflow its banks, and doing considerable damage to the hay crops in the adjoining fields. The inhabitants of Aston, Nechells, Saltley, and contiguous districts were for a time deprived of their customary water supply.

Purchase of the Pontypridd Gas-Works by the Local Board.—At the meeting of the Pontypridd Local Board last Friday week, the Chairman (Mr. D. Leyshon) reported that the members had had a conference with the Directors of the Gas Company, and had signed a provisional agreement, to be approved of by the shareholders, whereby the Board would purchase the works for £30,000. In addition to this, £5000 would be necessary to cover capital expenditure for the erection of new plant; but the Gas Company would pay the costs of an Act of Parliament for an extension of the gas-works and the laying down of mains to Cilfynydd and other outlying districts. The report was adopted; and it was arranged that the Board should pay the Company 5 per cent. interest on the purchase-money from the 1st of July, and receive in return the profits until the capital sum had been paid.

Electric Lighting for Barnsley.—A report of the Park and Lighting Committee of the Barnsley Town Council was issued last week on the question of electric lighting. The Borough Surveyor (Mr. J. H. Taylor) recommends two schemes, the largest of which is for a nominal output of 5000 8-candle power lamps and 31 1200-candle power arc lamps with 2½ miles of mains and feeders laid underground. The area contains eight dwelling-houses of more than £20 a year value; 252 shops; 11 mills, workshops, chapels, &c.; and Mr. Taylor believes that consumers for 2500 8-candle power lamps might be obtained within twelve months, especially as the Harvey Institute would require 1000. The cost of the plant and buildings would be £18,382. The working cost would be £2859; and the revenue, £4288—giving a net profit of £1429. Another calculation shows, with 2500 lamps, a net profit of £181. The Committee recommend—"That the electric light be installed on a site at Beckett Square, at an estimated cost of £18,382, but that at present only £13,332 be expended; that Mr. Bromley Holmes be the electrical engineer; that the Surveyor prepare plans of the buildings; and that application be made by the Council to the Local Government Board for sanction to borrow the £18,382.

Excursion of the York Gas Company's Employees.—On Saturday, the 2nd inst., the employees of the York Gas Company had their annual dinner at Scarborough; the chair being occupied by the Secretary and Manager (Mr. C. Sellers). In proposing the toast of the day, the Chairman referred to the fact that the Company was now being confronted with the electric light. However, he would not, he said, copy many electricians, who seemed to make it a rule to exaggerate the merits of their own light by grossly misrepresenting those of gaslight. Neither would he retaliate upon the conduct of certain more or less public men, who were continually gloating over their feather-headed anticipations that gas would soon be snuffed out, and that the people who had invested their money in it would soon lose it. This conduct was ungenerous, and the very opposite of creditable. It was true that the electric light was talked of in York, and certain would-be scientists had lost their heads about it. But as certain as they had lost their heads would they lose their money, if they launched their scheme upon the data which had been put before the city. This was not only his own opinion, but that of men who were free from local bias, and who thoroughly understood the question. The Chairman, in the course of his remarks, referred in appreciative terms to a new gas-lamp which has lately been devised to combine lighting with efficient ventilation; and concluded by reminding his hearers that the field for the uses of gas is widening every day, as the gas exhibition recently held in the city fully testified. The toast having been duly honoured, the health of Mrs. Sellers (the Chairman's mother) was drunk with great enthusiasm.

Water Supply to Small Houses.—The Water Committee of the Manchester Corporation have prepared a report, in compliance with a resolution of the Council passed on May 18 last, with reference to a proposal to reduce the charge for water supplied to baths in weekly houses. The matter is considered in some detail; and reasons are given why it is not expedient, at the present juncture, to make any alteration in the charges. Information has been obtained from eight large towns in respect to the charge for a house let at 7s. per week without a bath. They were found to vary very much. Birmingham, for instance, was 16s. per annum. It was considered, however, that the fairest mode would be to take an average of the eight towns. This was done, with the following result: Average of eight towns, 13s. 10d. per annum; charge in Manchester, 9s. 11d. per annum—showing that in Manchester at all events the Corporation do not charge an unreasonable price for water to small houses. "Another matter worthy of consideration," the Committee state, "and one that must be evident to all, is that very shortly Manchester, for sanitary reasons, will generally adopt the water-closet system or water-carriage for sewage. This being so, the occupants of all the houses will become entitled to a supply of water for water-closets without further charge. This will entail serious additional cost on the Corporation, as the consumption of water will thereby become largely increased, and the extra cost will have to be raised. It must be remembered that, if any further concession is made in the case of weekly houses, the loss the Committee will thereby sustain will have to be levied on the higher rated property. It may be safely said the smaller class of property is not at present, even with the charge for baths, paying its fair proportion in aid of the expenses which have to be met in regard to the supply of water; and it is quite clear that the present charge on all weekly property will have to be considerably raised if baths are to be allowed. When the Thirlmere works are completed, and the cost fully ascertained, the Committee will have to consider their financial position; and, no doubt, the whole of the incidence of taxation in regard to all property will then have to be adjusted. In their opinion, no alteration in the charges for water should be made at present; but all matters of charge should remain over until the Thirlmere works are finished, and the negotiations with the Government (by means of which it is hoped to obtain considerable relief for some years to come in the payment of sinking fund) are finally settled."

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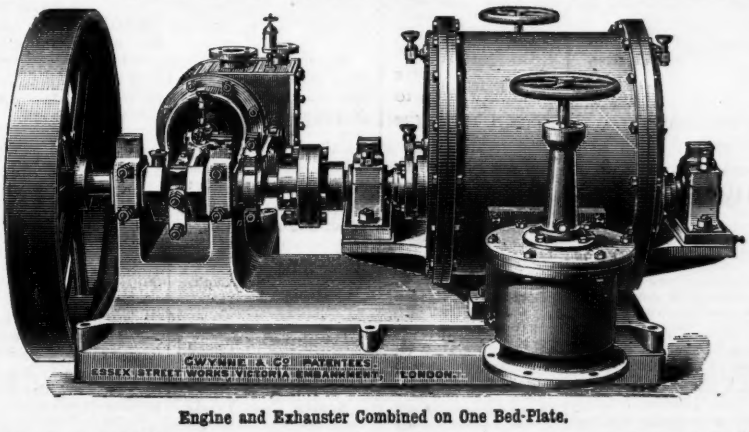

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GWYNNE & Co.'s Exhausters are constructed of large size to pass the required quantity of Gas at very slow speeds; the wear and tear being reduced to a Minimum.

Catalogues and Testimonials sent on Application.

Their Exhausters can be made, when desired, on their New Patent Principle, to pass Gas without the slightest oscillation or variation in pressure.

NO OTHER MAKER CAN DO THIS.

Makers of GAS-VALVES, HYDRAULIC REGULATORS, VACUUM GOVERNORS STEAM-PUMPS for Tar, Liquor, or Water; PATENT SELF SEALING AND CLEANSING RETORT-LIDS AND MOUTHPIECES; CENTRIFUGAL PUMPS and PUMPING ENGINES specially adapted for Water-Works raising Sewage, &c.

Also GIRARD and other TURBINES, HIGH-SPEED ENGINES, DYNAMOS, &c., &c., for ELECTRIC LIGHTING.

OXIDE OF IRON.

O'NEILL'S Oxide has a larger annual sale in the United Kingdom than all other Oxides ombined. Purity and uniformity of quality guaranteed. Pamphlet, "How to Purchase Bog Ore," to be obtained on application.
Gas Purification and Chemical Company, Limited, Palmerston Buildings, Old Broad Street, London, E.C.
JOHN WM. O'NEILL, Managing Director.

GAS PURIFICATION AND CHEMICAL COMPANY, LIMITED.

ANDREW STEPHENSON, Agent.
Please address all communications to the Company, as above.

ANDREW STEPHENSON, Agent for BRIN'S OXYGEN COMPANY, Limited, Westminster, S.W.
City Address: 182, Gresham House, Old Broad Street, LONDON, E.C.

WINKELMANN'S "Volcanic" Fire CEMENT. (Fire resistance, 4500° Fahr.)
Prices, particulars, and directions for use on application to ANDREW STEPHENSON, 182, Gresham House, Old Broad Street, LONDON, E.C.

CANNEL COAL, ETC.

JOHN ROMANS & SON, EDINBURGH.
Gas Engineers, supply all the most approved SCOTTISH CANNELS; also FIRE-CLAY GOODS, CAST-IRON PIPES, and other APPARATUS for GAS AND WATER WORKS.
Prices, &c., will be forwarded on application to No. 80, ST. ANDREW SQUARE, EDINBURGH, or NEWTON GRANGE, NEAR DALKEITH, } SCOTLAND.

OXIDE OF IRON FOR GAS PURIFICATION.

JAMES GORDON & Co., Brokers, can offer Cargoes of good quality; also 2500 tons of SPENT OXIDE.
Samples and price on application.
Address Borough Buildings, 7, Rumford Street, LIVERPOOL.

MAINLAYER seeks employment to go abroad. Has been abroad before. Good references.
Address L. SCOTT, 59, Beadnell Road, FOREST HILL, S.E.

WANTED, by the Advertiser (age 29), a Situation as CLERK or SECRETARY to a Gas Company, or is open to accept an engagement as TRAVELLER. Nine years' experience on a Carbonizing Works. No objection to going abroad.
Address No. 2114, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

TO GAS COMPANIES, ETC.

WANTED, by an experienced man, a situation as GAS MANAGER of Works making from 10 to 25 millions per annum, or GENERAL FOREMAN of large Works. Thorough practical knowledge of Gas Manufacture and Distribution and the Testing of Gas. High testimonials from previous employers and reference to present situation, where the make is about 80 millions. Advertiser wishes to better his position.
Address No. 2115, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

WANTED, a steady and trustworthy STOKER, one used to Engine and Exhauster and Shovel Charging. Permanent employment to a suitable man. Wages 35s. per week.
Apply, stating age, whether married or single, with copies of testimonials, to Mr. A. REEVES, Hythe and Sandgate Gas Company, Hythe, KENT.

BRISTOL WATER-WORKS COMPANY.

FOREMAN Wanted, with thorough knowledge and previous experience of the duties.
Apply by letter, stating present employment, age, wages now received, with *copies* of testimonials, to be sent in not later than July 19, and addressed to
ALFRED J. ALEXANDER,
General Manager.
Water-Works Office, Bristol,
July 5, 1892.

COUNTY BOROUGH OF HUDDERSFIELD.
(GAS DEPARTMENT.)

WORKS FOREMAN.

WANTED, a General Foreman for a Works making 500,000,000 cubic feet per annum, competent to take charge under the Manager. He must be a good Carbonizer, and able to superintend the various processes of Purification, &c. A man who has had a mechanical training will be preferred.
Applications will only be considered from those who are holding similar positions, and over 30 and under 45 years of age; and must be in Candidate's own handwriting, on foolscap paper, stating age and full particulars as to present position and experience, and accompanied by not more than three recent testimonials. Letters to be addressed to Mr. W. R. Herring, Engineer and Manager, Gas-Works, Huddersfield, and be sent on or before the 20th inst., endorsed "Foreman."
Wages 50s. per week; and the man appointed will be required to reside near the Works, and to devote his whole time to the duties assigned to him, which will necessitate his presence at the Works during the evening.
H. BARBER,
Town Clerk.
Town Hall, Huddersfield
July 7, 1892.

JAMES LAWRIE & CO. supply Best SCOTCH CANNEL COALS, Best FIRE-CLAY RETORTS, BRICKS, TILES, and LUMPS; BOILER SEATING BLOCKS, FLUE COVERS, and SILICA BRICKS for SPECIAL FURNACE WORK; COKE BARROWS, BOGIES, and SMALL WAGONS.
Postal Address: 1, WHITTINGTON AVENUE, E.C.
Telegram Address: "EIRWAL LONDON."

W. C. HOLMES & Co., Huddersfield, AND 80, CANNON STREET, LONDON,
Contractors for Gas-Works complete, Makers of Gasholders, Purifiers, Scrubbers, Condensers, Retort Fittings, &c., Improved Valves, Engines, and Exhausters. Also for Collingwood's Regenerative Retort-Settings.
, See Advertisement p. III., centre of JOURNAL.
Cablegrams: "Ignitor London." Telegrams: "Holmes Huddersfield."

J. & J. BRADDOCK, Globe Meter Works, Oldham.
First-Class Award, Melbourne Exhibition, 1889, for WET AND DRY GAS-METERS, STATION METERS, AND GOVERNORS, PRESSURE-GAUGES, STREET LAMPS AND PILLARS, &c.
Telegraphic Address: "Braddock, Oldham."

SADLER AND CO., LIMITED, MIDDLESBROUGH; ULVERSTON (BARROW); PORTSMOUTH; CARLTON; STOCKTON; 70, Wellington Street, GLASGOW; 58, Fountain Street, MANCHESTER; and 85, Water Street, NEW YORK. Tar Distillers, Manufacturers of all TAR PRODUCTS, ALIZARINE and other TAR COLOURS, BICHROMES, OXALIC ACID, ALKALIES, LIQUOR AMMONIA, AMMONIA SULPHATE, &c.
Head Office: MIDDLESBROUGH. Correspondence invited.

PORTER & CO., Gowts Bridge Works, LINCOLN, Engineers, Ironfounders, and Contractors, for the erection of Gas-Works for Towns, Villages, Mansions, Manufactories, Collieries, and Isolated Buildings, at home and abroad. Manufacturers of Retorts and Fittings, Condensers, Scrubbers, Purifiers, Valves, &c.; also of Girders, Wrought and Cast Iron Tanks, Iron Roofs, &c.
Telegraphic Address: "PORTER, LINCOLN."

MR. J. C. CHAPMAN, Fellow of the Chartered Institute of Patent Agents, advises on all matters connected with LETTERS PATENT FOR INVENTIONS and the PROTECTION OF TRADE MARKS, &c., at home and abroad. Preliminary Information and Handbook on application.
70, Chancery Lane, LONDON, W.C.

WANTED, for the Sutton Valence Gas Company, a PRACTICAL MAN in Gas Making, with a knowledge of Fitting, Main laying, Retort setting, and Meter taking. Good references required.
Apply to EDWARD LONG, Secretary.

MANAGER OF GAS-WORKS.

THE Corporation of Evesham will, on the 1st of December next, or earlier (if arranged), require a MANAGER for their Gas-Works. House, Fuel, and Light free. About 1700 tons of coal carbonized per annum. Population about 6300.
Applications, in own writing, stating salary required and age, and (fully and concisely) qualifications, with testimonials, and date (approximately) when duties could be entered upon, to be sent to me the undersigned on or before July 24.
THOS. COX,
Town Clerk.
Evesham,
June 29, 1892.

THE Newcastle and Gateshead Gas Company require an ASSISTANT MANAGER or GENERAL FOREMAN for their Gateshead Works, where the largest make is about 4 millions a day. He must be capable of taking the entire management of the Works in the absence of the Manager, and have a good general knowledge in all departments.
Applications, in own handwriting, with three recent testimonials of character and ability, and stating age, where now employed, when at liberty, and salary expected, to be addressed to the Chairman, Gas Office, Newcastle-on-Tyne, not later than the 1st day of August.
W. HARDIE,
Secretary.
June 27, 1892.

BANDON TOWN COMMISSIONERS (CO. CORK).

MANAGER FOR GAS-WORKS.

WANTED, a Competent Person for the above position. Salary, £80 a year, with House, Fuel, and Light, also Garden.
Applications, with copies of testimonials, to be lodged with the undersigned at or before Ten o'clock a.m., on Tuesday, July 19, 1892.
By order,
JOHN M'DONNELL,
Town Clerk.
Board-Room, Bandon,
July 4, 1892.

WANTED, a Good Second-hand Tested STATION METER, with Bye-Pass complete, to pass 1200 feet per hour.
State price and particulars to A. B. C., Post Office, Nacton, near IPSWICH.

WANTED, two Second-hand Purifiers, about 6 feet square, with two Four-Way Valves and Connections complete for same. Must be in first-class condition. Also FOR SALE two 4 feet square PURIFIERS, complete, in good condition, cheap.
Address, S. G. TULK, Gas-Works, Aberdovey, NORTH WALES.

IRISH BOG ORE OXIDE OF IRON.

GAS PURIFICATION.

BALE, BAKER, & CO., direct Importers from Ireland. Sample and Price on application.
OXIDE PAINT, SULPHURIC ACID, & Chemicals.
120 and 121, NEWGATE STREET, LONDON, E.C.

OLPHERT'S OXIDE.

FINEST Quality of Natural Bog Ore Apply for particulars to the Sole Agent, Mr. THOS. L. ARCHER, Cathedral Chambers, Half Street, MANCHESTER.

SULPHURIC ACID.

JOHN NICHOLSON & SONS, Chemical Works, LEEDS, specially produce this ACID from BRIMSTONE, for making SULPHATE OF AMMONIA of high quality and *good* colour. Delivery in our own Railway Tank-Wagons or Carboys. Highest references and all particulars supplied on application.

OXIDE OF IRON. Genuine Natural Bog ORE. QUALITY AND CONDITION GUARANTEED. Any quantity supplied at lowest rates.
D. M. NELSON AND SONS, 68, Bath Street, GLASGOW. Telegraphic Address: "Gas, Glasgow." Depôts throughout England and Scotland.

AUTOMATIC Apparatus for Charging AND DISCHARGING GAS-RETORTS. Coze and Morris and Van Vestraut's Systems. See Advertisement p. IV., centre of last week's JOURNAL.
Inquiries should be addressed to THE AUTOMATIC COAL-GAS RETORT COMPANY, LIMITED, 86-88A, LEADENHALL STREET, E.C.

LIQUOR and Tar wanted.
BROTHERTON AND Co., Ammonia and Tar Distillers, LEEDS and WAKEFIELD.

RAILWAY TANKS for Hire. First- class condition.
BROTHERTON AND Co., LEEDS.

DRAWINGS, Tracings, Specifications, Quantities, &c., prepared by an experienced Engineering Draughtsman. Plans of Works made, copied, or enlarged. Blue copies made. Illuminated Addresses in first-class style. Writings of all kinds, Engrossments, &c.
Address J. L. FEATHERSTONE, 173, Fentiman Road, LONDON, S.W.

FRIEDRICH LUX, Ludwigshafen am Rhein; and at No. 142, Great Portland Street, London, W.
LUX'S Gas Regulators for every consumption.
LUX'S single-stem Pressure-Gauges.
LUX'S Regulator for Gas-Engines.
LUX'S Gas-Balance.
LUX'S new Gas Regulator for Inverted Lamps and other Apparatus for Gas Lighting, &c.

GAS-METERS FOR SALE.

THE Royal Agricultural Hall Company, Limited, Islington, have FOR SALE one 500-LIGHT DRY METER, and one 200-LIGHT DRY METER, which until recently have been used at the Hall, and are in good working order.
Apply to R. VENNER, Secretary, Royal Agricultural Hall Company, Limited, ISLINGTON.

FOR SALE—A perfectly new 20,000 cubic feet per hour EXHAUSTER, with Steam-Engine combined, including Hydraulic Gas Governor, Bye-Pass Valves, and Connections.
For further particulars, apply to Mr. T. G. MARSH, 41, Corporation Street, MANCHESTER.

FOR SALE—Patent Self-Sealing Retort MOUTHPIECES (seven 16-inch Circular, and two Ovals, 22 in. by 15 in. and 21 in. by 15 in.), taken out for larger size. Guaranteed in good condition, and equal to new. Will be sold cheap.
Apply to JOHN A. HARRIS, Manager, Gas-Works GREAT WIGSTON.

COAL TAR FOR SALE.

PROPOSALS are invited for 50,000 gallons of COAL TAR, to be delivered f.o.b Limerick in tanks or casks, to be supplied by Purchaser. Immediate delivery will be given. Payment net Cash on delivery. All communications to be addressed to the MANAGER, Gas Offices, LIMERICK.
July 5, 1892.

COUNTY BOROUGH OF STOCKPORT.
(GAS DEPARTMENT.)

TO IRONFOUNDERS, ETC.

THE Gas Committee are prepared to receive TENDERS for the supply of about—
600 yards of 9 inch diameter CAST-IRON MAINS.
Weight per yard not to exceed 34 lbs.
600 yards of 4 inch diameter CAST-IRON MAINS.
Weight per yard not to exceed 46 lbs.
IRREGULARS for both sizes.
Tenders, endorsed "Mains," and addressed to the Chairman of the Gas Committee, Millgate Gas-Works, Stockport, to be sent in on or before the 21st of July, 1892. Deliveries to commence on the 1st of August, 1892.
The resolution of the Council that Contractors will be expected to pay the average rate of wages paid in the district will apply to this contract.
Forms of Tender and any further Information may be obtained on application to the Engineer, Mr. S. Meunier, Stockport.
The Committee do not bind themselves to accept the lowest or any tender.
By order,
WALTER HYDE,
Town Clerk.
July 8, 1892

GAS COAL.

THE Directors of the Oakham Gas Company, Limited, invite TENDERS for about 750 tons of good GAS COAL or NUTS.

For particulars apply to

JAS. MASON,
Manager.

ROMSEY GAS AND COKE COMPANY, LIMITED.

TENDERS are invited for the supply and delivery at Romsey Station of about 700 tons of SOUTH YORKSHIRE GAS COAL or NUTS during the next Twelve months, in such quantities and at such times as the undersigned may direct.

Tenders to be addressed to

W. FAULKNER,
Manager.

TAUNTON GASLIGHT AND COKE COMPANY.

THE Directors are prepared to receive TENDERS for the supply of GAS COAL, of good quality, over Ten months commencing the 1st of August next.

Tenders to the undersigned on or before the 14th inst.

A. EDWARDS,
Secretary and Manager.

TENDERS FOR GAS COALS.

THE Directors of the Petworth Coal Gas and Coke Company invite TENDERS for the supply of 800 tons of EAST PONTOP, PELAW MAIN, ALDWARKE, or other good GAS COAL, delivered free at Petworth Railway Station, as required.

Tenders to be sent to the undersigned on or before Friday, July 29.

THOS. R. LEPPARD,
Manager and Secretary.

Petworth, July 8, 1892.

TENDERS FOR TAR.

THE Dukinfield Local Board invite TENDERS for the TAR produced at the Gas-Works during the ensuing Twelve months and amounting to about 650 tons.

Tenders to be sent in by Noon on Monday, the 25th of July, at Local Board, King Street.

HARRISON VEEVERS,
Engineer.

Dukinfield,
July 9, 1892.

BOROUGH OF ROTHERHAM.

COAL CONTRACTS.

THE Gas Committee invite Tenders for the supply and delivery at the Gas-Works, Frederick Street, Rotherham, of 13,000 tons of best screened GAS COAL.

Further Particulars and Form of Tender may be had on application to the Gas Engineer, Mr. C. B. Newton.

Sealed tenders to be sent to me not later than Wednesday, the 20th inst, endorsed "Tender for Coal."

By order,
H. H. HICKMOTT,
Town Clerk.

Council Hall, Rotherham,
July 8, 1892.

GREAT WIGSTON GAS COMPANY.

TENDERS FOR COAL.

THE Directors invite Tenders for 1900 to 2100 tons of best screened GAS COAL (21 cwt. to the ton), delivered at the Railway Station, Wigston, for Twelve months, commencing July 1, 1892, in such quantities as the Manager shall order from time to time.

Tenders to be addressed to the Chairman not later than the 25th of July inst.

The Directors do not bind themselves to accept the lowest or any tender.

JOHN A. HARRIS,
Manager.

July 8, 1892.

TENDERS FOR GAS COAL.

THE Directors of the Exmouth Gas Company invite TENDERS for the supply of about 2000 tons of clean, dry, unscreened, fresh wrought GAS COAL.

Tenders to be for price f.o.b.; also price delivered free at Exmouth Docks, between the 1st of August next and the 30th of June, 1893, accompanied by working analysis.

Sealed tenders, addressed to the Chairman, and endorsed "Tender for Coal," to be delivered to the Company's Office not later than Saturday, July 30, 1892.

No tender necessarily accepted.

By order,
JAMES T. FOSTER,
Secretary.

Gas-Works, Exmouth,
July 5, 1892.

TIPTON GAS-WORKS.

TO ENGINEERS AND IRONFOUNDERS.

THE Gas Committee of the Tipton Local Board are prepared to receive TENDERS for the supply and erection of a WASHER or SCRUBBER, capable of dealing with a production of 1,000,000 cubic feet of Gas per day.

Further particulars may be obtained at the Gas-Works, on application to Mr. Vincent Hughes, the Engineer.

Detail Drawing and Specification to accompany Tenders, and also list stating where similar Washers are at work.

Sealed and endorsed tenders to be sent to me, the undersigned, not later than Ten a.m., on Friday, the 22nd of July inst.

The Committee do not bind themselves to accept the lowest or any tender.

By order,
GEO. M. WARING,
Clerk to the Board.

Public Offices, Tipton,
July 7, 189.

TO CONTRACTORS.

THE Market Harborough Gas Company invite TENDERS for

2000 Tons of screened GAS COAL.
100 Tons of LIME.
26 Tons of SULPHURIC ACID.

The Coal must be sent in monthly, and as directed by the Manager, Mr. Armitage, of whom any further information may be obtained.

Tenders, giving price per ton at Market Harborough Station, to be sent to Wm. Gilbert, Esq., Northampton Road, Market Harborough, by the 1st of August next.

The lowest or any tender not necessarily accepted.

CHAS. BURGOINE,
Clerk.

July 9, 1892.

BOROUGH OF CHORLEY.

TO TAR DISTILLERS AND OTHERS.

THE Chorley Corporation invite Tenders for the purchase of the surplus TAR produced at their Gas-Works for Twelve months, commencing the 1st of August next, delivered in Contractor's Tanks at the Chorley Railway Station.

Approximate quantity, 450 tons.

Any further information may be obtained from Mr. R. Fearnley, Gas Manager, Chorley.

The Corporation do not bind themselves to accept the highest or any tender.

Tenders, endorsed "Tar," to be sent to me on or before Tuesday, the 19th of July inst.

By order,
THOS. A. JACKSON,
Town Clerk.

Chorley, July 5, 1892.

CITY OF BELFAST.

CONTRACT FOR COAL.

THE Gas Committee of the Belfast Corporation invite TENDERS for a supply of 110,000 tons of best screened GAS COAL, to be delivered free and trimmed in Barges at Belfast Harbour, between Sept. 1, 1892, and Aug. 31, 1893.

No tender for less than 10,000 tons will be considered.

Monthly quantities and particulars may be obtained from the Manager of the Gas-Works.

Tenders, on Office Forms, endorsed "Tender for Coal," should be delivered at my Office not later than the 20th of July.

The lowest or any tender not necessarily accepted.

SAMUEL BLACK,
Town Clerk.

BOROUGH OF BURTON-UPON-TRENT.

OXIDE OF IRON.

THE Mayor, Aldermen, and Burgesses of the Borough of Burton-upon-Trent, acting by the Council, are prepared to receive TENDERS for the supply of about 100 tons of OXIDE OF IRON, to be delivered, in Truc's, at the Gas-Works Railway Siding, Burton-upon-Trent, in such quantities and at such times as may be directed by the Gas Manager.

Tenders, enclosed in an Envelope, and endorsed "Oxide of Iron," are to be delivered to me at or before Ten a.m., on Friday, the 22nd of July inst.

The Council do not bind themselves to accept the lowest or any tender.

(Signed) F. L. RAMSDEN,
Manager and Engineer.

Gas-Works, Burton-upon-Trent,
July 11, 1892.

TENDERS FOR GAS COAL.

THE Directors of the Clayton, Allerton, and Thornton Gas Company invite TENDERS for the supply of 5000 tons of GAS COAL and 500 tons of CANNEL COAL. The Coal to be Screened, free from Scale, Sulphurous Pyrites, or other objectionable matter, and to be delivered at the Gas-Works, Low Lane, Clayton, or at the Great Northern Railway Station, Clayton, in such quantities weekly as may be ordered by the Company's Manager, during the next Twelve months. The said tenders to state the Seam and the Pit from which the Coal is intended to be sent.

Sealed tenders, endorsed "Tender for Gas Coal," addressed to the Chairman, at the Gas-Works, to be delivered at or before Noon on Monday, the 25th day of July, 1892.

The Directors do not pledge themselves to accept the lowest or any tender, reserving to themselves the right to divide the contracts as they may think proper.

By order,
JOHN NIVEN,
Secretary and Manager.

Gas Offices, Clayton,
near Bradford, July 8, 1892.

WALLASEY GAS-WORKS.

TO TAR DISTILLERS AND OTHERS.

THE Wallasey Local Board are pre- pared to receive TENDERS for the purchase of AMMONIACAL LIQUOR (about 2000 tons per annum), and also of the surplus GAS TAR (about 1000 tons per annum), produced from time to time at their Gas-Works, Great Float, near Birkenhead, during a period of One, Two, or Three years from the 30th of September next.

A pipe is laid between the Gas-Works and the Great Float for the conveyance of the Tar and Liquor into the Contractor's Boats; and the Board will, if necessary, provide appliances on their own Siding to pump the products direct into the Contractor's Railway Tank-Wagons.

Any further information may be obtained on application to Mr. H. Ashton Hill, Gas and Water Manager to the Board.

Sealed tenders, endorsed "Tar, &c.," and addressed to the Chairman of the Gas and Water Committee, to be left at my Office, as below, not later than Five o'clock in the afternoon of Monday, the 25th inst.

The Board do not bind themselves to accept the highest or any tender.

By order,
W. DANGER,
Clerk to the Board.

Public Offices, Egremont,
Cheshire, July 8, 1892.

MESSRS. DEBENHAM, TEWSON, FARMER, and BRIDGEWATER'S MONTHLY LIST of Shops, Show-Rooms, Factories, and Waterside Premises, suitable for the Exhibition and Manufacture of Engineering and other Appliances, may be obtained, free of charge, at their Offices, 80, CHEAPSIDE, E.C.

LINCOLN CORPORATION.

(GAS DEPARTMENT).

TENDERS FOR COAL.

THE Gas Committee of the Lincoln Cor- poration invite TENDERS for the supply of 19,000 tons of screened GAS COAL, COBBLES, and NUTS, to be delivered during a period commencing the 1st of August, 1892, and terminating the 30th of June 1893.

Further particulars and Forms of Tender may be obtained from the undersigned.

Sealed and endorsed tenders, addressed to the Chairman of the Gas Committee, must be delivered on or before the 23rd inst.

The Committee do not bind themselves to accept the lowest or any tender.

JNO. CARTER, Manager.

Gas Offices, Lincoln,
July 4, 1892.

LINCOLN CORPORATION.

(GAS DEPARTMENT.)

TENDERS FOR TAR & AMMONIACAL LIQUOR.

THE Gas Committee of the Corporation of Lincoln are prepared to receive TENDERS for the purchase of the surplus TAR, and of the whole of the AMMONIACAL LIQUOR produced at their Works during the period of One year, commencing on the 1st of July, 1892.

Sealed tenders, addressed to the Chairman of the Gas Committee, and endorsed "Tender for Residuals," must be delivered at the Gas Offices, Newland, on or before the 23rd inst.

The Committee do not bind themselves to accept the highest or any tender.

Information as to quantities and other particulars may be obtained of the undersigned.

JNO. CARTER, Manager.

Gas-Works, Lincoln,
July 4, 1892.

BOROUGH OF NELSON.

(GAS DEPARTMENT.)

THE Gas Committee of the above Cor- poration invite TENDERS for the supply an erection of four 12 feet square PURIFIER COVERS and INLET and OUTLET PIPES, 3 ft. 3 in. diameter for new Gasholder.

Plans and Specifications can be seen at the Office of the Engineer, Mr. W. Foster, Gas-Works, Nelson.

Form of Tender may be obtained from the Engineer, on deposit of One Guinea, which will be returned on receipt of *bonâ fide* tender.

Sealed tenders, endorsed "Purifier Covers and Pipes," and addressed to Mr. R. M. Prescott, Town Hall, Nelson, to be sent in on or before Monday, the 18th day of July, 1892.

The Committee do not bind themselves to accept the lowest or any tender.

By order,
R. M. PRESCOTT,
Town Clerk.

Town Hall, Nelson,
July 2, 1892.

TENDERS FOR GAS COAL.

THE Directors of the Enfield Gas Com- pany invite TENDERS for the supply of about 6000 tons per annum of GAS COAL, to be delivered on the Company's Railway Siding at their Works at Ponders End.

The Coals tendered for are to be Barrow Old Silkstone from the Barrow Collieries and other suitable Coal, delivered in such quantities and at such times as the Company may direct, and are to be free from Hards, Smudge, Dirt, or other Impurities.

The Tenders can be for One, Two, or Three Years, commencing the 1st of August, 1892, and must comply with the usual conditions of the Company, which can be obtained on application to the Secretary, Mr. John Purdey, Enfield, Middlesex.

Sealed tenders, endorsed on cover "Tender for Gas Coal," to be sent to the Secretary of the Company at Enfield, Middlesex, on or before the 20th of July inst.

The Board do not bind themselves to accept the lowest or any tender.

JAMES COLLYER,
Acting-Chairman.

Enfield,
July 13, 1892.

BOROUGH OF WALSALL CORPORATION.

(GAS DEPARTMENT.)

TO IRONFOUNDERS, ROOF CONSTRUCTORS, AND OTHERS.

THE Gas Committee of the Corporation of Walsall invite TENDERS for the construction, in accordance with a Specification and Drawings prepared by Mr. John Tindall, Gas Engineer to the Corporation, and which may be seen at the Borough Offices, Bridge Street, Walsall, of a THREE-SPAN IRON ROOF, which is to cover a Retort-House and Coal-Stores now in course of erection at the Pleck Gas-Works. The centre Span will be 68 feet wide from centre to centre of the Cast-Iron Columns, and 290 feet long; and the two side Spans will be each 32 feet wide.

Further information as to details can be ascertained on application to the Gas Engineer.

Tenders, sealed and marked outside "Tender for Retort-House Roof," are to be sent to the undersigned on or before Saturday, the 30th inst.

The Corporation do not bind themselves to accept the lowest or any tender; and they will not accept the tender of any firm or person paying less than the standard rate of wages current in the district.

JOHN R. COOPER,
Town Clerk.

Walsall,
July 9, 1892.

GAS COAL.

BEST
REAL OLD SILKSTONE GAS COAL,
Address THE STRAFFORD COLLIERIES COMPANY,
Near BARNSLEY, SOUTH YORKSHIRE.

ISSUE OF STOCKS AND SHARES BY AUCTION
UNDER PARLIAMENTARY POWERS.

MR. ALFRED RICHARDS undertakes the issuing by Auction of GAS and WATER SHARES under Parliamentary Powers.

He also holds MONTHLY SALES of GAS and WATER SHARES, at the Auction Mart, Tokenhouse Yard, E.C.

The next Sale will take place at the Mart on Monday, July 25, at One for Two o'clock precisely, by order of the Directors of the Romford Gas Company, the Executors of the late T. Knight, Esq., and others, of Shares and Stock in the following Undertakings:—

Romford Gas and Coke Company.
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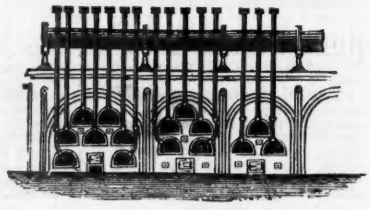

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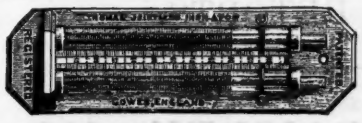

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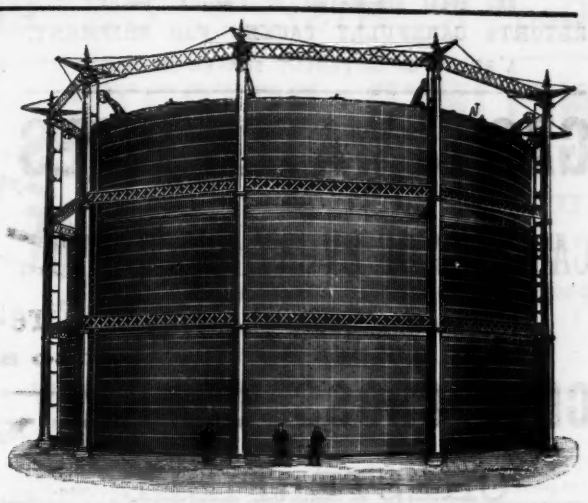

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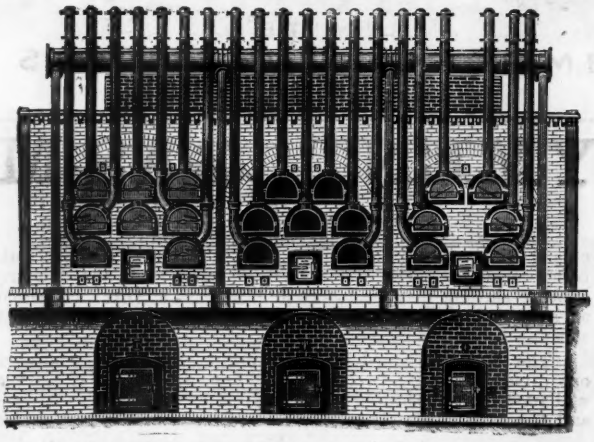

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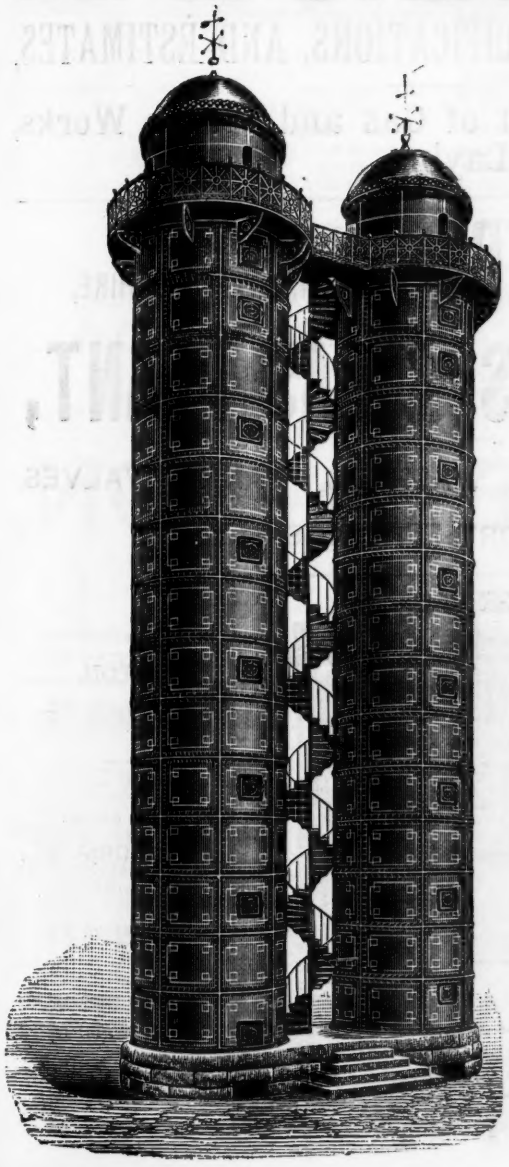

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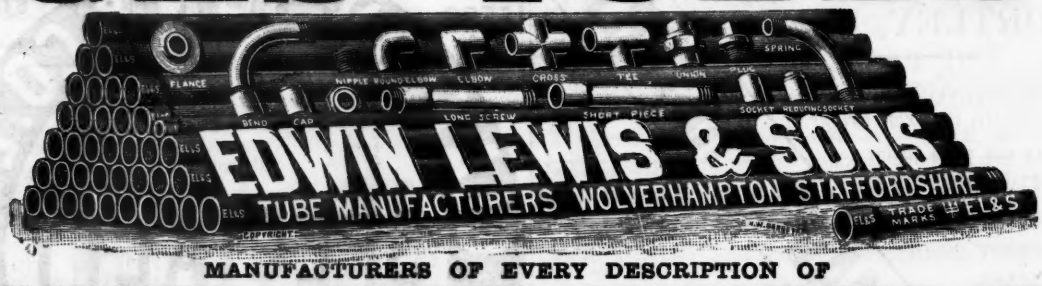

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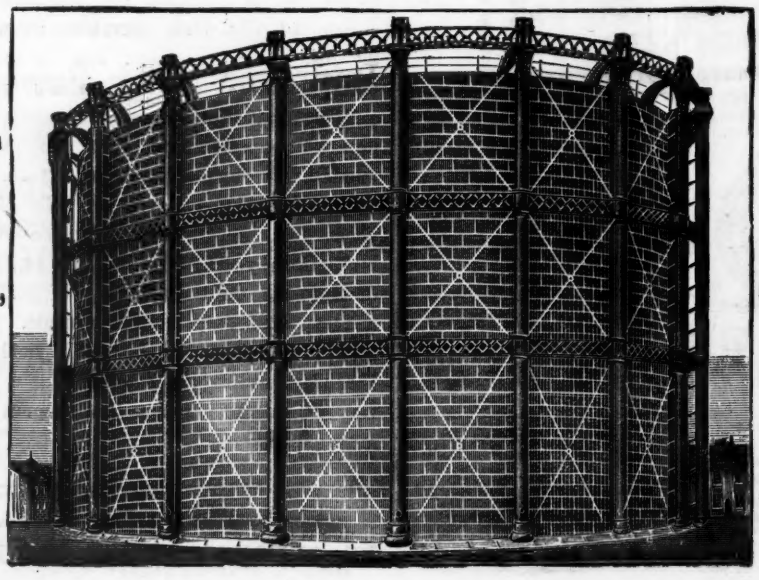

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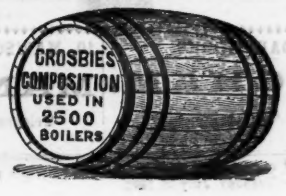

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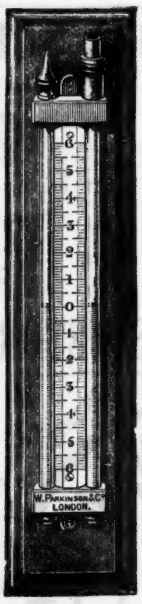

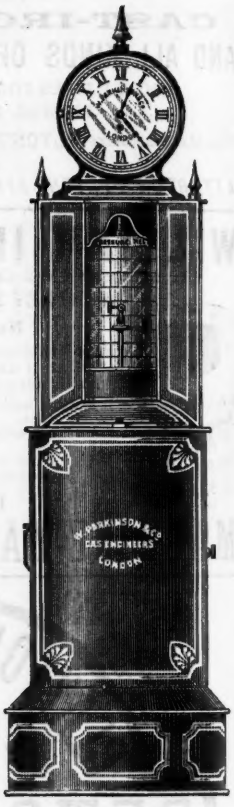

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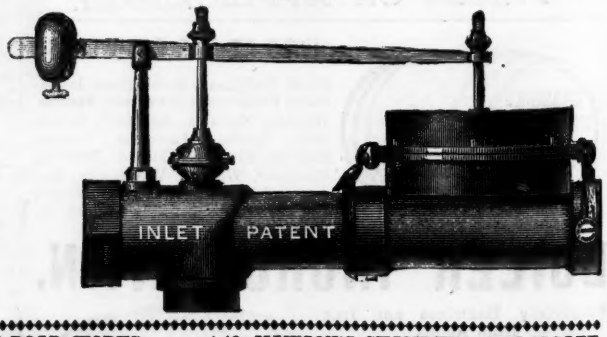

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[See also Advt., p. 60.

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